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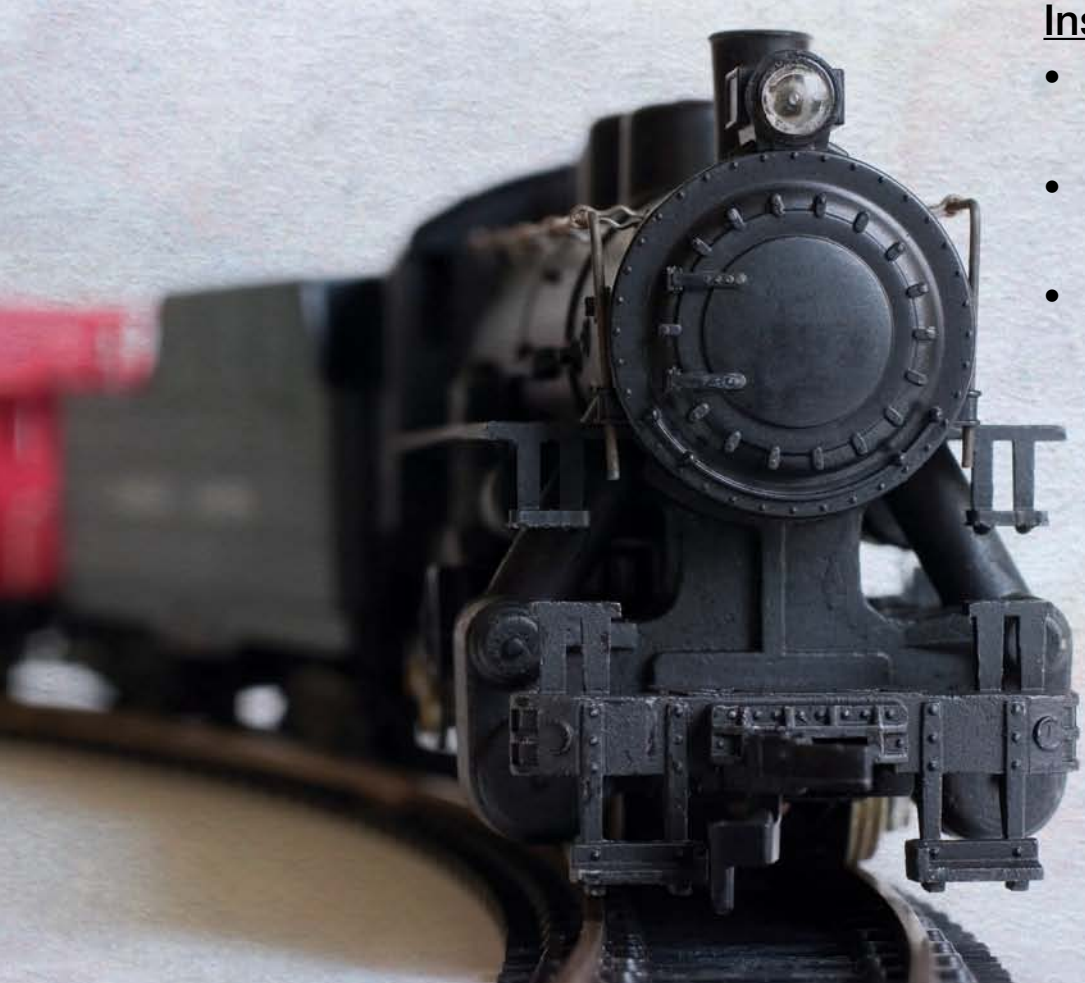
Amber Waves

The Economics of Food, Farming, Natural Resources, and Rural America

NAFTA Countries Looking Beyond Member Countries to Expand Trade



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U.S. Ethanol Use Dampens Global Crude Oil Prices

Ethanol is the world's most widely used liquid biofuel in the transportation sector. A recent ERS study found that increasing ethanol in the U.S. gasoline supply would lead to lower crude oil prices than would otherwise have been the case. A one-time 5-percent increase in U.S. ethanol use will lower the crude oil price by an estimated 8 cents per barrel over 12 months.

The U.S. is the world's largest ethanol producer and currently holds a 57-percent share of global ethanol production. In 2010, about 13 billion gallons of ethanol were blended into the U.S. gasoline supply, accounting for about 9.5 percent of gasoline consumption. The Renewable Fuel Standard (RFS) established by the Energy Independence and Security Act (EISA) of 2007 mandates annual use of 36 billion gallons of renewable fuel in the U.S. by 2022. If the RFS is met, ethanol's share of U.S. gasoline consumption could reach 25 percent within the next 10 years.

The impact of U.S. ethanol use on crude oil markets will become important as the portion of gasoline blended from ethanol grows from its current level of around 10 percent to the RFS level of 25 percent by 2022. Given the role that petroleum prices can play in economic growth prospects, global economic forecasts should take into account the outlook for the U.S. ethanol industry because of its effect on crude oil prices. Fluctuations in crude oil prices affect global consumption, production, and trade patterns. Abnormally high prices can contribute to downturns in the world economy.

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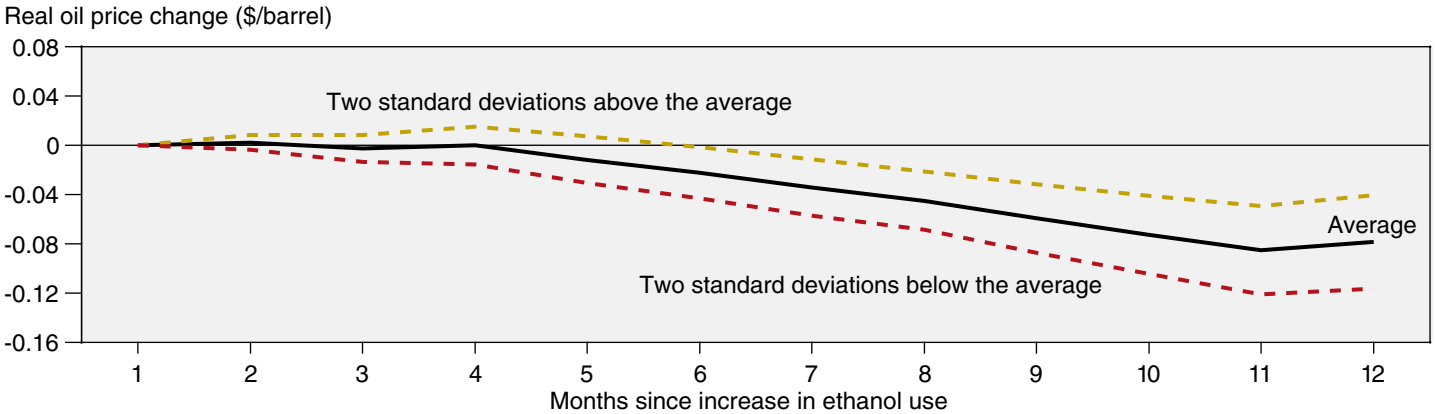
This finding is drawn from . . .

"Assessing the Impact of U.S. Ethanol on Fossil Fuel Markets: A Structural VAR Approach," by Lihong Lu McPhail, in *Energy Economics*, April 2011.

A 5-percent increase in ethanol use could lower global crude oil prices



Note: Solid line represents average (mean) impact of a 5-percent increase in ethanol use from the previous month. Dotted lines represent two standard deviations from the mean (95 percent of the observations will fall within this range).

Source: USDA, Economic Research Service using data from U.S. Department of Energy, Energy Information Administration, and the Nebraska Energy Office website.

Steven Vaughn, USDA/ARS

Market Potential for U.S. Distillers' Grains Exceeds Likely Supply Growth

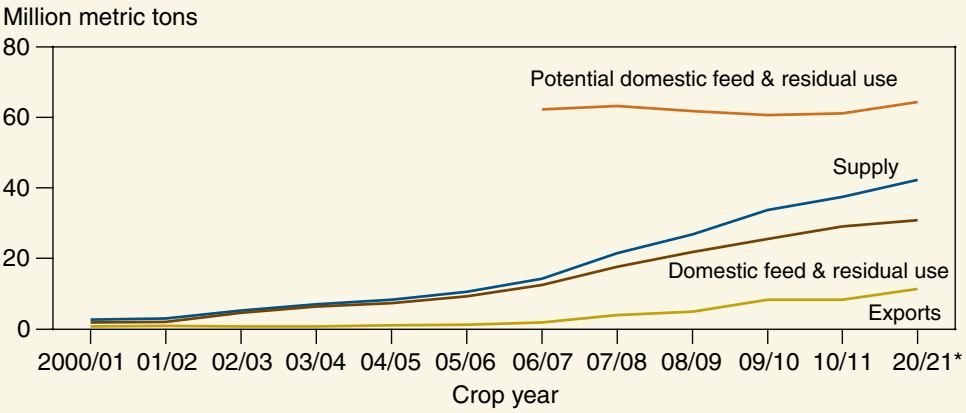
U.S. production of distillers' grains (DGs), which include a range of animal feed co-products derived from corn-based dry-mill ethanol production, has quadrupled since 2004/05, paralleling the rapid growth of U.S. ethanol production. Despite initial concerns about the capacity of domestic or foreign livestock feeders to utilize DGs, they are now the second largest category of processed feed used in the U.S., amounting to an estimated 29.1 million metric tons (mmt) in 2010/11. ERS projections point to further growth in DGs production. For the foreseeable future, however, potential feed use of DGs in the U.S. exceeds projected supply.

Initially, observers questioned the industry's ability to process and market a high-quality, storeable DGs product and the degree to which the nutritional characteristics were suited to certain types of livestock/poultry. Nevertheless, both domestic and international feeders rapidly adopted DGs, which possess at least the same energy as corn and protein content between that of corn and soybean meal. All livestock and poultry can use the nutrients from DGs, but beef and dairy cattle (ruminants) can use them more readily than hogs and poultry (monogastrics). Furthermore, technological advances are making it possible to change the composition of DGs and tailor them to the nutrient needs of each type of animal.

As much as one-quarter of U.S. DGs supply has been exported, which will support continued growth in DGs use. Main markets include China, Mexico, and Canada. Exports have benefited from technical assistance from U.S. trade groups.

ERS researchers developed a methodology to compute the U.S. supply, as well as actual and potential feed use of DGs. Based on midrange diet inclusion rates suggested by animal nutritionists for different types of livestock and poultry, the analysis shows that potential feed use of DGs could have averaged 62 mmt during the past 5 years, far above estimated actual domestic DGs feed consumption of 29.1 mmt and supply of 37.4 mmt for 2010/11. With production growth of corn-based ethanol and corresponding DGs expected to slow in the next 10 years and with exports of DGs expected to grow, actual domestic feed use of DGs projected for 2020/21 is only about half the projected potential feed use demand of 64 mmt.

Potential feed use of distillers' grains in the U.S. exceeds supply



*Projected.
Source: USDA, Economic Research Service, updated calculations from Hoffman and Baker (2010, p. 5) and Hoffman and Baker (2011) and USDA, *World Agricultural Supply and Demand Estimates*, September 12, 2011, and *USDA Agricultural Projections for 2011-20*, February 2011.

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This finding is drawn from . . .

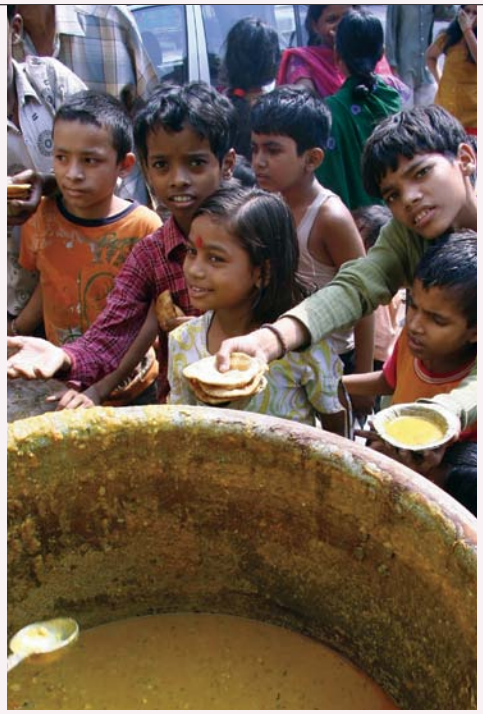
Market Issues and Prospects for U.S. Distillers' Grains Supply, Use, and Price Relationships, by Linwood A. Hoffman and Allen Baker, Outlook Report No. FDS-10K-01, USDA, Economic Research Service, December 2010, available at: www.ers.usda.gov/publications/fds/2010/11nov/fds10k01/

Estimating the Substitution of Distillers' Grains for Corn and Soybean Meal in the U.S. Feed Complex, by Linwood A. Hoffman and Allen Baker, Outlook Report No. FDS–11-I-01, USDA, Economic Research Service, October 2011, available at: www.ers.usda.gov/publications/fds/2011/09sep/fds11i01/

Counting India's Food Insecure Is Complicated

The most recent USDA global food-security assessment (based on estimates of national food availability) indicates that India accounted for the single largest share of the world's food-insecure population in 2010—about 28 percent. However, based on a household consumption survey conducted by the Indian Government, ERS research reveals that estimates of food insecurity are sensitive to alternative calculation methods, even when high-quality household consumption data are available. Food-security estimates, therefore, can vary widely depending on the estimation methods used.

Using survey data for approximately 125,000 households collected by the Indian Government during 2004/05, ERS computed household calorie purchases and the share of the population that is food insecure. Food insecurity is defined as limited or uncertain availability of nutritionally adequate foods. ERS used 2,100 calories per day as the average per capita minimum requirement for all countries.



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The estimates of the food-insecure population were particularly sensitive to assumptions made regarding the calorie content of processed foods, which cannot be directly computed from the survey data. To test the sensitivity, researchers used alternative assumptions to compute the calorie content of processed and unprocessed foods eaten both at home and away from home. Calculations using alternative assumptions, all equally plausible, resulted in a 173-million-person difference between the high and low estimates of India's food-insecure population in 2005. This difference is equivalent to about 22 percent of India's total food-insecure population estimated by USDA for 2005. Use of the alternative assumptions also led to significant differences in the distribution of Indian households by food-security status, particularly those classified as least and most food insecure.

Given the potential for error in food insecurity measurements, even when reliable household data are available, the accuracy of study results may be strengthened when researchers corroborate assessments using alternative indicators. Information from household surveys can be combined with information on aggregate food availability, such as the ERS *International Food Security Assessment, 2011-21* or *The State of Food Insecurity in the World, 2010*, published by the United Nations Food and Agriculture Organization, and health indicators of undernourishment. Researchers can also consider strengthening household survey instruments to reduce measurement error in key areas, including the caloric intake associated with the growing consumption of processed foods and meals eaten outside the home.

Alternative assumptions about calories purchased led to significant differences in estimated food security of Indian households in 2005

Daily per capita calorie consumption	High-calorie estimate	Low-calorie estimate	Difference[1]
	Percent of Indian households		
Food insecure			
Calories < 1,500	6.4	15.1	-8.7
1,500 < Cal < 1,800	13.3	19.8	-6.5
1,800 < Cal < 2,100	19.8	21.3	-1.5
Food secure			
2,100 < Cal < 2,400	19.6	16.7	2.9
Cal > 2,400	40.8	27.0	13.8

[1]Significant at the 1-percent level.

Source: USDA, Economic Research Service using data and sample weights from the 61st round of India's National Sample Survey.

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This finding is drawn from . . .

"The Sensitivity of Food Security in India to Alternate Estimation Methods," by Sharad Tandon and Maurice R. Landes, in *Economic and Political Weekly* (India), May 28, 2011, Vol. XLVI, No. 22, pp. 92-99.

Avian Influenza Boosted Japan's Imports of Dried Egg Products

Fawzi Taha, USDA/ERS

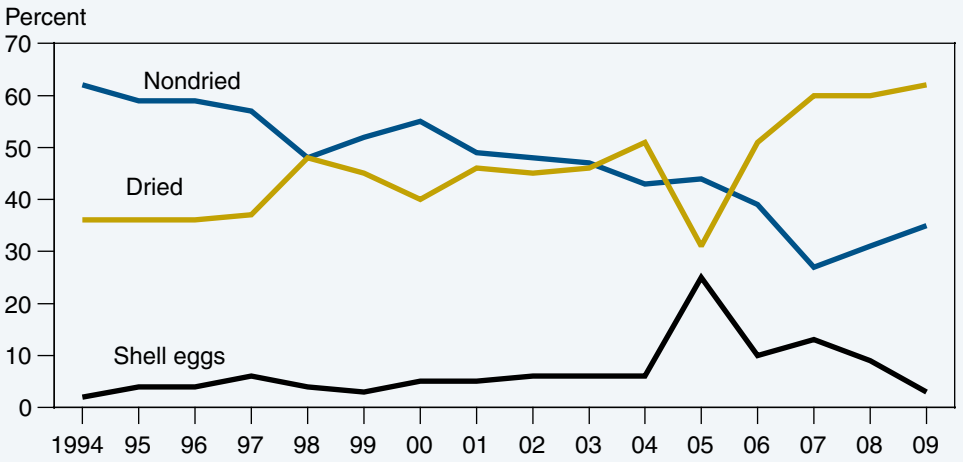
Animal disease outbreaks can have major trade impacts. ERS analysis of the effects of the 2004 outbreak of highly pathogenic avian influenza (HPAI) H5N1-virus in Japan showed evidence of a willingness of Japanese consumers to substitute—for food safety reasons—processed dried egg products for fresh shell eggs. These changes in preference affect U.S. exports of shell eggs and egg products.

ERS researchers divided Japan's egg imports into shell eggs, nondried egg products, and dried egg products. Fresh eggs are the most likely to carry the virus on the shell surface as well as inside, while dried egg products are produced through heating that kills the virus.

Data on Japan's egg imports following the outbreak showed a change in demand in shell eggs and dried egg products. In the post-HPAI period, Japanese importing firms viewed the two products as closer substitutes for each other. In addition, the demand for each class of products became more sensitive to price changes. Import demand for the safer dried egg products increased and import demand for the nondried egg product and shell eggs weakened.

Despite reduced demand for shell eggs, shell egg imports still rose sixfold in 2005, due to the loss of Japanese layers to HPAI. The U.S. supplied the largest share—38 percent—valued at $5.7 million. After 2006, as Japan's layer flocks began to recover, shell egg imports decreased dramatically and imports of dried egg products rose.

Japanese imports of dried eggs rose following avian influenza outbreaks in 2004



Source: USDA, Economic Research Service using *World Trade Atlas* data.

Within the dried-egg-product category, demand for U.S. exports of dried egg whites increased from 6 percent of Japan's egg imports in 2004 to 42 percent (worth $6.03 million) in 2007. By 2010, U.S. global export volumes of dried egg whites increased fourfold from 2004 (worth $13.17 million), and U.S. shipments to Japan rose more than twelvefold. The study has wide-ranging implications for global egg markets because it provided the first evidence for a possible substitution of dried egg products for shell eggs.

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This finding is drawn from . . .

"Highly Pathogenic Avian Influenza Impacts on Japan's Import Demand for Shell Eggs and Processed Egg Products," by Fawzi A. Taha and William F. Hahn, in *World's Poultry Science Journal*, Vol. 67, March 2011, pp 115-130.

A Wide Variety of Fruit and Vegetables Are Affordable for SNAP Recipients

The 2010 *Dietary Guidelines for Americans* recommends increased vegetable and fruit intake and a variety of vegetables, especially dark-green vegetables, red and orange vegetables, and beans and peas. As demonstrated by ChooseMyPlate.gov, fruit and vegetables should account for about half of a consumer's plate. But can participants in USDA's Supplemental Nutrition Assistance Program (SNAP) afford a wide selection of fruit and vegetables or just the few least expensive types? Recent ERS research suggests that low-income Americans can meet the *Dietary Guidelines* for fruit and vegetable consumption with a wide selection of fresh and processed products and stay within a limited budget.

Using ERS's 2008 Fruit and Vegetable Prices database, researchers assembled a selection of fruit and vegetables that satisfy the 2010 *Dietary Guidelines* and do not exceed a budget based on USDA's Thrifty Food Plan (TFP). The TFP demonstrates how people with limited resources can acquire a nutritious diet at a minimal cost. For a family of four, the weekly TFP food budget in 2008 was $135.80, of which $54.32, or 40 percent, was earmarked for fruit and vegetables.

A moderately active family of four following the *Dietary Guidelines* would need to consume a total of 53 cups of fruit and 74 cups of vegetables per week. The *Dietary Guidelines* report fruit and vegetable recommendations in cup equivalents—

In 2008, a family of four could purchase the recommended amount of fruit and vegetables for just under $54 per week—40 percent of the Thrifty Food Plan budget

Products (units bought)	Total cup equivalents*	Total retail cost
Fruit	*Number*	*Dollars*
Apples, fresh (9)	15.6	4.33
Cantaloupe, fresh (1)**	3.6	2.28
Oranges, fresh (4)	3.0	1.03
Bananas, fresh (4)	2.2	0.47
Raisins, 12-oz bag (1)	4.7	1.82
Pears, 15.25-oz can (3)**	5.2	3.00
Orange juice, 12-oz frozen concentrated (4)	24.0	6.12
Vegetables		
Romaine hearts, fresh (3)	5.9	2.38
Broccoli florets, fresh, 12-oz bag (1)**	2.2	1.38
Whole kernel corn, 15-oz can (3)	5.3	1.94
Potatoes, boiled from fresh, peeled (10)	15.7	3.02
Green peas, frozen, 1-lb bag (1)**	2.6	1.34
Green pepper, fresh (1)**	0.8	0.68
Cabbage, boiled or steamed (1)	5.3	1.43
Onions, fresh (3)	2.6	0.74
Celery, fresh 1.5-lb bag (1)	4.1	1.35
Cauliflower, raw (1)	7.1	2.20
Baby carrots, 1-pound bag (3)	10.6	4.20
Sweet potatoes, boiled from fresh (4)	3.3	1.43
Tomatoes, 14.5-oz can (5)	8.6	3.49
Tomatoes, grape, 1 pint (2)**	3.4	4.14
Red bell pepper, fresh (1)**	0.8	1.10
Navy beans, 15.5-oz can (2)	3.4	1.59
Pinto beans, 15.5-oz can (3)	5.2	1.98
Total fruit	58.3	19.05
Total vegetables	86.9	34.39
Total fruit and vegetables	145.2	53.44

Notes: The family of four includes a male and a female age 40, one boy age 10, and one girl age 7.
*A cup equivalent is the edible portion that will generally fit in a 1-cup measuring cup. For lettuce and other raw leafy greens, it is the amount that will fit in 2 cups; and for raisins and other dried fruit, it is the amount that will fit in ½ cup.
**Costs more than 50 cents per cup equivalent.

Source: USDA, Economic Research Service.

generally the amount of edible food needed to fill a measuring cup. In their calculations, ERS researchers allotted an additional 10 percent in purchased quantities to account for household food losses, such as spoilage and other factors, with the potential to lower consumption. Likewise, USDA food plans for lower income Americans assume that 5 to 10 percent of edible food is not consumed.

The resulting sample list of fruit and vegetables is an example of a combination that meets the *Dietary Guidelines* within the TFP budget. The list consists of many produce items costing less than 50 cents per cup equivalent—about one-third of the 153 items in the 2008 ERS database. Due to package sizing, the SNAP household in this case actually bought more vegetables than it needed for the week but stayed within its budget.

By choosing lower cost items, such as potatoes, apples, and bananas, a household also could afford some higher cost items. This sample list includes a few items that cost more than 50 cents a cup, such as grape tomatoes and cantaloupe. Another household might choose to purchase freshly squeezed orange juice and economize somewhere else.

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This article is drawn from . . .

"Can Low-Income Americans Afford to Satisfy MyPyramid Fruit and Vegetable Guidelines?" by Hayden Stewart, Jeffrey Hyman, Elizabeth Frazão, and Andrea Carlson, in *Journal of Nutrition Education and Behavior*, 2011(43):pp. 173-9.

ERS Data on Fruit and Vegetable Prices, available at: www.ers.usda.gov/data/fruitvegetablecosts/

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FINDINGS

The Information Age and Adoption of Precision Agriculture

USDA/NRCS

Precision agriculture comprises a range of information technologies—such as yield monitors, global positioning systems (GPS), variable rate technology, and guidance systems—that farmers can use to better manage their agricultural production practices. These information technologies have the potential to reduce fuel and input expenses by enabling farmers to optimize the application of seed, fertilizer, and pesticides (see Farms, Firms, and Households chart, page 51).

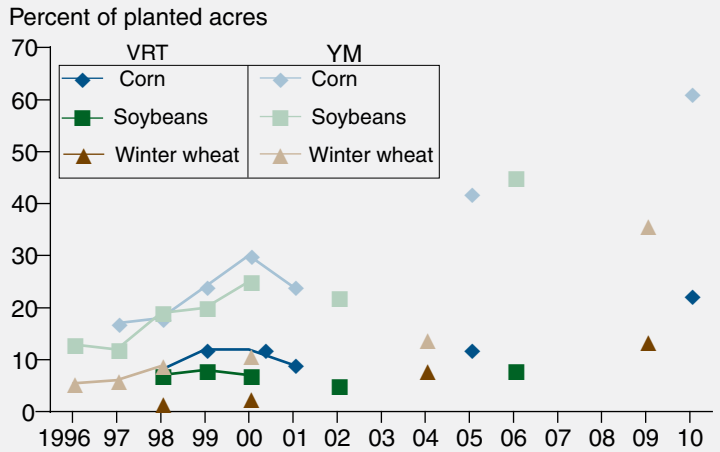
Farmers have traditionally applied fertilizer, for example, at a uniform rate that matches the highest requirement of a crop in any part of a field. But if growing conditions vary within the field, some parts of it may receive too much fertilizer, resulting in increased farm and environmental costs. Excessive or poorly timed application can contribute to nutrient runoff from farms into wells, waterways, wetlands, and estuaries. Nitrogen fertilizer, when over-applied and not incorporated into the soil, can oxidize and vaporize into a potent greenhouse gas. By enabling farmers to better match the application of fertilizers and other inputs to crop needs, precision agriculture helps mitigate these effects.

Yield monitors, the most widely used precision equipment, have been available on harvesting combines for decades but are now capable of attaching GPS location coordinates to specific yields in each part of a farmer's field. Guidance systems and auto-steering, which use GPS data to notify farm equipment operators of their exact field position, have become increasingly popular and were used on roughly 35 percent of U.S. wheat acreage in 2009.

Variable rate technologies (VRT) allow for the application of fertilizer, pesticide, and seed at different rates as the equipment moves across a field. Farmers using VRT may maximize the benefits of the technology by also using detailed field maps constructed with GPS data. These maps are not simple to create, but some farmers are combining geographic information systems with their yield and soil maps to keep track of multiple field and crop characteristics.

Despite the potential for improved production efficiency, farmers have been slow to adopt variable rate technologies, and the expected impacts on farm structure, employment, and environmental quality have not been fully realized. Research suggests that low adoption rates may be due to uncertainty about the economic returns from large initial investments in precision equipment, the complexity of these technologies, and the need to make integrated use of several precision technologies to obtain cost savings.

Yield monitor adoption outpaced that of variable rate technology for major crops



Note: VRT= Variable rate technology. YM= Yield monitors.

Source: USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey.

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This finding is drawn from . . .

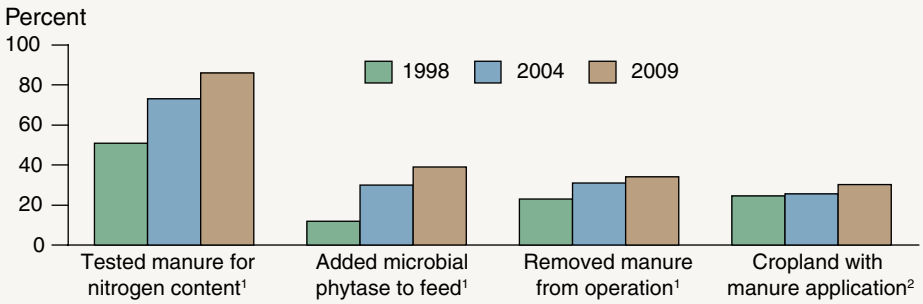
On the Doorstep of the Information Age: Recent Adoption of Precision Agriculture, by David Schimmelpfennig and Robert Ebel, EIB-80, USDA, Economic Research Service, August 2011, available at: www.ers.usda.gov/publications/eib80/

Use of Conservation-Compatible Manure Management Practices Increases on U.S. Hog Farms

U.S. hog producers altered their manure management decisions between 1998 and 2009, suggesting an increased focus on applying nutrients at agronomic rates—that is, at levels that do not exceed what can be absorbed by crops. Over this period, hog producers applied manure to a larger share of their cropland, were more likely to remove manure from their operations, increased nutrient testing of manure, expanded their use of feed additives that reduce phosphorus in hog manure, and were more likely to have a comprehensive nutrient management plan (CNMP). Many of these shifts in manure management decisions were the result of changes in the location and size of hog operations, increasing fertilizer prices, a greater number and stricter enforcement of regulations, and more remunerative cost-share programs.

Between 1998 and 2009, hog production in the U.S. shifted to larger operations. The number of hog operations fell by about 60 percent during the period, and average inventory grew from about 2,590 to 7,930 head. With the shift to larger operations, an increasing share of production now falls under the purview of regulations governing the application of manure nutrients to cropland. Larger farms with less cropland available per head for spreading manure are more likely than other farms to remove manure from the operation, to apply manure to crops with a high rate of nutrient uptake (such as Bermuda grass), to add microbial phytase to feed, to test soil for nutrients, and to follow a CNMP.

The share of hogs raised on operations using conservation-compatible manure management practices increased between 1998 and 2009



[1]Percent of operations, weighted by animal units, which are defined as 1,000 pounds of live animal weight.
[2]Percent of cropland with manure application, weighted by animal units.

Source: USDA, Economic Research Service using data from USDA's 1998, 2004, and 2009 Agricultural Resource Management Surveys.

The decline in the intensity of manure applications on land by the largest operations, and increased use of CNMPs, may be a response to an increasing number of Federal and State policies designed to reduce the over-application of manure nutrients. In 2009, 55 percent of hog farms, representing 82 percent of total animal units (defined as 1,000 pounds of live animal weight) in the U.S., followed a nutrient management plan, compared with 30 percent in 2004. The share of farms receiving USDA payments to help defray the costs of meeting regulations also increased substantially over this period (see Resources and Environment chart on pp 51).

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This finding is drawn from . . .

Trends and Developments in Hog Manure Management: 1998-2009, by Nigel Key, William D. McBride, Marc Ribaudo, and Stacy Sneeringer, EIB-81, USDA, Economic Research Service, September 2011, available at: www.ers.usda.gov/publications/eib81/

USDA/NRCS

John Cromartie, USDA/ERS

Hispanics Contribute to Increasing Diversity in Rural America

During a decade of diminished population growth across rural and small-town America, Hispanic population growth and geographic dispersion during 2000-2010 was a strong driver of demographic change, as it has been for at least two decades. According to census data released in 2011, just over 51 million people lived in U.S. nonmetro counties in April 2010. Between April 2000 and 2010, the nonmetro population added 2.2 million people, less than half that added during the "rural rebound" of the 1990s.

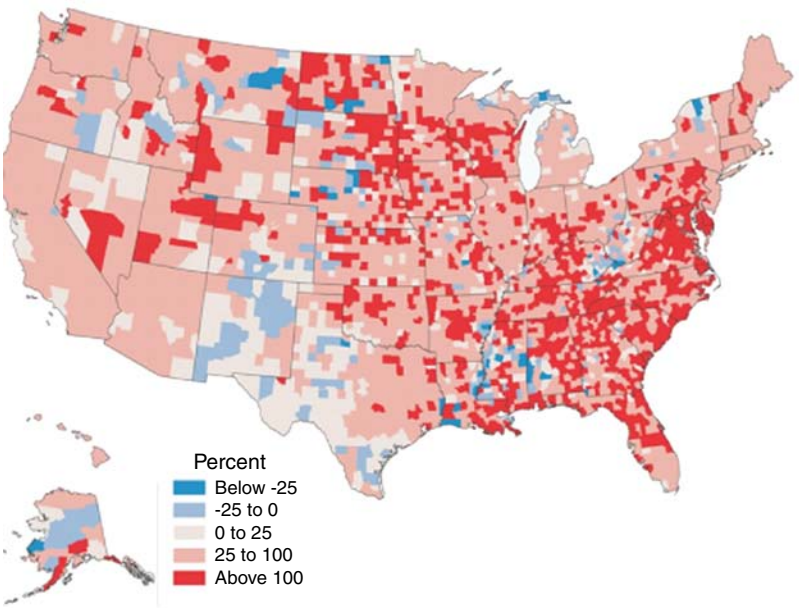
While the overall nonmetro population grew 4.5 percent in the 2000s, the nonmetro Hispanic population increased 45 percent. And Hispanic population growth was not confined to areas with large Hispanic concentrations in the Southwest. On a percentage basis, growth was significantly higher throughout much of the Southeast, Midwest, and Northwest, as it was during the 1990s.

The nonmetro population as a whole became more geographically concentrated during 2000-2010, with populations shifting away from very rural, isolated settings toward more densely settled and more metro-accessible counties. Population declined by 1.3 percent in the 433 nonmetro counties that were not adjacent to any metro area and that did not include any urban area of 2,500 or more people, but it grew by 6.9 percent in nonmetro counties containing cities of 20,000 or more people (whether adjacent or not).

At the same time, population dispersion was much more prevalent among nonmetro Hispanics. Their population grew by 42 percent in the 433 completely rural, nonadjacent counties, just a few percentage points below the 46-percent rate for Hispanics in highly urbanized counties.

Hispanic populations more than doubled in most nonmetro counties in the South and in many otherwise slow-growing or declining sections of the Nation's Heartland. In 228 nonmetro counties, overall population loss was avoided because Hispanic population growth more than offset non-Hispanic population decline. In many of these otherwise-declining nonmetro counties, Hispanic population growth was fueled by demand for low-skilled food-processing and manufacturing workers during the 2000s. However, expanding service-sector jobs also attracted Hispanics into scenic areas in the West and elsewhere, where Hispanic inmigration was linked with population growth among retirees and other amenity-seeking migrants. These new settlement patterns increase the visibility of Hispanics in many new regions of rural America whose population has long been dominated by non-Hispanic Whites.

Nonmetropolitan counties experienced high rates of population growth among Hispanics between 2000 and 2010



Source: USDA, Economic Research Service using data from the 2010 Census of Population.

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This finding is drawn from . . .

ERS Atlas of Rural and Small-Town America, available at: www.ers.usda.gov/data/ruralatlas/

Jeff Vanuga, USDA/NRCS

Hired Farm Labor Held Steady in Great Recession

After declining for much of the previous decade, the employment of hired farm laborers, supervisors, and managers stabilized in 2008 and rose somewhat in 2009 and 2010, according to data from USDA's National Agricultural Statistics Service's Farm Labor Survey. Hired farmworkers were one of the few categories of predominantly manual laborers that did not suffer large employment losses during the Great Recession of 2007-09.

In July 2011—fully 2 years after the official end of the recession—total nonfarm wage and salary employment was still 5 percent below its pre-recession peak, according to preliminary estimates from the Bureau of Labor Statistics. Data from the Current Population Survey indicate that nonfarm wage and salary employment fell 11 percent between 2007 and 2010 for those with no more than a high school degree, while farm employment for workers with this level of education held steady.

Real (adjusted for inflation) wages, however, grew more slowly in the farm sector than elsewhere. Average hourly wages for nonsupervisory crop and livestock workers rose 2.4 percent from $9.98 in 2007 to $10.22 in 2010 (in constant 2010 dollars), while those for nonfarm production workers increased 4 percent to $19.07.

Agricultural employment trends partly reflect underlying trends in the value of agricultural production, which grew from $328 billion in 2007 to $356 billion in 2010. However, much of this increase was driven by greater production of crops that use relatively little hired labor, namely feed crops and oilseeds, for which production grew by almost $20 billion, or 30 percent, over this period. In contrast, fruit, tree nuts, nursery and greenhouse commodities, and dairy products, which together accounted for 61 percent of all U.S. farm labor expenses in 2008, experienced either more moderate output growth (12 percent for vegetables) or reductions in the value of output (11 percent for dairy).

Overall, hired labor's share of net value added in agriculture slipped slightly, from 20.6 percent in 2007 to 19.3 percent in 2010, in part reflecting the shift in production shares toward less labor-intensive crops.

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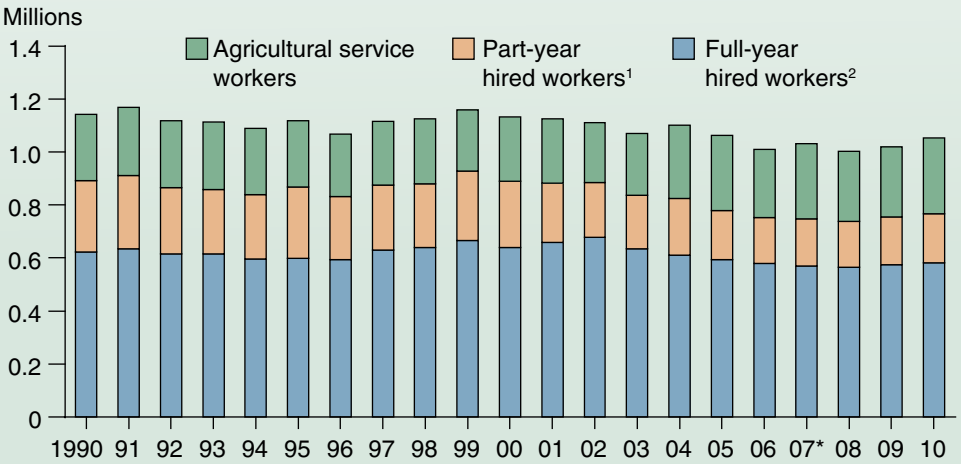
Hired farm labor employment has been relatively steady in recent years



Notes: Data for 2007 are estimates based on survey data for April, July, and October and on modeled data for January. [1]"Part-year" farmworkers are those who expected to work less than 150 days in a particular year. [2]"Full-year" farmworkers are those who expected to work 150 days or more in a year.

Source: USDA, Economic Research Service using data from USDA's National Agricultural Statistics Service's Farm Labor Survey.

This finding is drawn from . . .

The Farm Labor chapter of the ERS Briefing Room on Rural Labor and Education, available at: www.ers.usda.gov/briefing/laborandeducation/farmlabor.htm

CBP

The NAFTA Countries Build on Free Trade

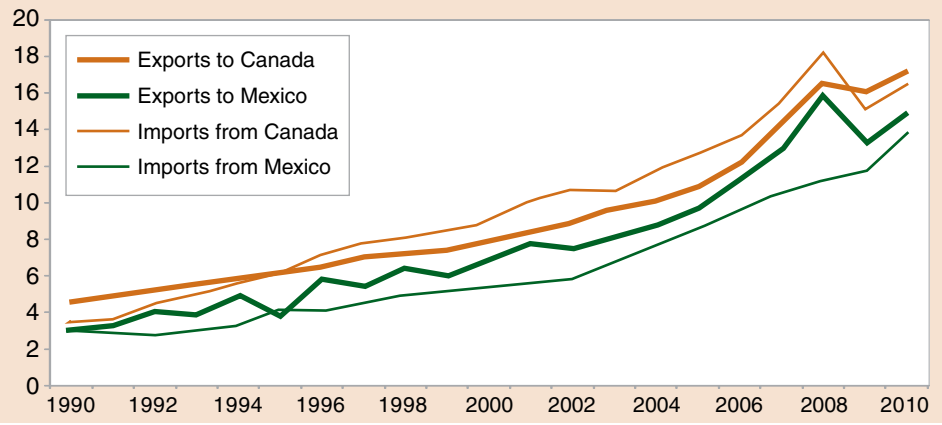
Steven Zahniser, zahniser@ers.usda.gov

- The North American Free Trade Agreement (NAFTA) is now an integral part of the North American agricultural economy, though some cross-border bottlenecks remain.
- Efforts to strengthen agricultural trade under NAFTA are focusing on regulatory cooperation, long-haul trucking, dispute resolution in produce trade, and refining NAFTA's rules of origin.
- Recognizing market opportunities outside North America, each NAFTA country is seeking more open trading relationships with non-NAFTA countries.

Free trade is deeply rooted within North America's agricultural economy. Canada, Mexico, and the United States gradually removed thousands of barriers to regional agricultural trade from 1994 to 2008 as part of the North American Free Trade Agreement (NAFTA). From 1989 to 1993, Canada and the United States pursued agricultural trade liberalization through the Canada-U.S. Free Trade Agreement (CUSTA), which was then folded into NAFTA. Mexico also implemented a number of unilateral agricultural trade reforms in the early 1990s. When these initiatives are considered together, the NAFTA countries have completed a remarkable two decades of agricultural trade liberalization.

Since NAFTA's implementation in 1994, U.S. agricultural trade with Canada and Mexico has flourished

Billions of U.S. dollars



NAFTA = North American Free Trade Agreement.
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Census Bureau, Foreign Trade Statistics, as cited by USDA, Foreign Agricultural Service, *Global Agricultural Trade System*.

Regional agricultural trade has generally flourished since NAFTA's implementation, and the agricultural economies of the three NAFTA countries have become far more integrated. Between 1993 and 2010, annual U.S. agricultural exports to Canada rose from $5.3 billion to $16.9 billion, while corresponding exports to Mexico increased from $3.6 billion to $14.6 billion. Meanwhile, annual U.S. agricultural imports from Canada expanded from $4.7 billion to $16.2 billion, and agricultural imports from Mexico rose from $2.7 billion to $13.6 billion. For fiscal year 2012 (October 1, 2011, to September 30, 2012), U.S. agricultural exports to Canada and Mexico are forecast to reach $19.0 billion and $17.0 billion, respectively, and corresponding imports from Canada and Mexico are forecast to equal $19.8 billion and $17.6 billion, respectively. Of course, only a portion of these increases can be attributed to NAFTA, as other factors such as population growth, macroeconomic performance, and technological change have also affected regional agricultural trade.

What's next for the NAFTA countries now that the free-trade area is firmly established? Changes in the world's demographics and economics are likely to increase the relative importance of markets outside the NAFTA region. For instance, China recently surpassed Canada and Mexico to become the largest customer for U.S. agricultural exports. At the same time, opportunities for trade and investment are expanding within North America. To help consumers and producers capitalize on these prospects, the NAFTA governments are seeking more open trading relationships with non-NAFTA countries, as well as increased commerce within the North American free-trade area.

Where Are North America's New Agricultural Markets?

According to the U.S. Census Bureau, the world's population is projected to grow from 7.0 billion to 8.4 billion during 2012-32, with 93 percent of the increase occurring in non-NAFTA countries. Two

The NAFTA region is expected to see major demographic changes over the next two decades

Country	Total midyear population			Annual population growth rate			Median age, midyear		
	2012	2022	2032	2012	2022	2032	2012	2022	2032
	Millions			*Percent*			*Years*		
United States	316	348	380	0.96	0.92	0.84	37.0	37.9	38.8
Canada	34	37	39	0.78	0.65	0.44	41.2	43.1	44.6
Mexico	115	127	137	1.09	0.88	0.64	27.4	31.0	34.5

Source: USDA, Economic Research Service, using data from U.S. Department of Commerce, Census Bureau, *International Data Base*.

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continents account for 87 percent of the projected increase: Asia, due to its large current population, and Africa, with projected rapid population growth. In addition, real (inflation-adjusted) per capita income growth in several Asian countries is expected to average more than 5 percent per annum over the next 20 years, well above the average annual rates projected for the United States (1.77 percent), Canada (1.65 percent), and Mexico (2.08 percent).

Census projections also indicate that the NAFTA region will be a growing market. This growth will mainly be driven by the U.S., which, among the NAFTA countries, is expected to have the largest increase in population over the next decades. Between 2012 and 2032, the region's population is projected to increase by 64 million in the U.S., 22 million in Mexico, and 5 million in Canada. This anticipated growth will heighten the attractiveness of the U.S. market, not only to Canadian and Mexican producers, who enjoy duty-free access because of NAFTA, but also to U.S. producers.

The rates of population growth in each NAFTA country, however, are projected to slow over the next 20 years. For Canada, this deceleration will be particularly sharp, from 0.78 percent growth annually in 2012 to 0.44 percent 20 years later. Among the world's major agricultural exporters, Canada and the European Union are among the few that anticipate little increase in domestic demand in the coming two decades.

The median age of the population in each NAFTA country will also increase over the next two decades, particularly in Mexico. A 2007 ERS study of U.S. household food expenditures suggests that the aging of the population is likely to lower per capita spending on food and shift demand toward fruit and vegetables and away from eating at restaurants and other foodservice establishments.

In Mexico, however, the aging of the population will initially coincide with a reduced number of dependents (defined as children plus persons over age 65) per working-age adult, a development that could help to boost household incomes and food demand. In a 2005 study, *Building Human Capital in an Aging Mexico*, Richard Jackson emphasizes that the number of dependents in Mexico is projected to decline from roughly 80 per 100 working-age adults in 2005 to 65 in 2030 and then start to increase as the Mexican population ages.

According to the same study, Mexico's brief demographic dividend of fewer dependents per working-age adult may diminish pressures on social service budgets, facilitate higher savings rates and larger investments in education, foster a shift toward more capital-intensive economic activities, and decrease international migration—all factors that could lead to higher rates of economic growth. This, in turn, could increase levels of food spending per capita, which tends to rise with household income.

Looking Outward

Cognizant of the market opportunities that lie outside North America, all three NAFTA governments are participating in multilateral trade negotiations at the World Trade Organization and negotiating additional regional and bilateral trade agreements. One of the main U.S. regional initiatives is the Trans-Pacific Partnership (TPP), an effort to foster greater economic integration in the Asia-Pacific region. The TPP involves eight other countries: Australia, Brunei Darussalam, Chile, Malaysia, New Zealand, Peru, Singapore, and Vietnam. In May 2011, the trade ministers of the TPP countries expressed their goal of reaching the broad outlines of an agreement by November.

The United States also has signed trade agreements with Colombia (2006), Panama (2007), and South Korea (2007), and in October 2011, these agreements were approved by the U.S. Congress. Leading up to the agreement's submission to Congress, the United States worked closely with the governments of these countries on important issues associated with the agreements—labor rights with Colombia, tax information with Panama, and automotive trade with Korea.

Efforts to secure congressional approval of these agreements were also intertwined with the objective of securing a long-term extension of the Trade Adjustment Assistance (TAA) Program, which provides job training, income support, job search and relocation allowances, and other forms of assistance to U.S. workers who lost their jobs or whose hours of work and wages were reduced as a result of increased imports. Trade adjustment assistance was one governmental activity that facilitated U.S. adjustment to trade liberalization under NAFTA. A NAFTA-focused variant of the TAA Program—the NAFTA-Transitional Adjustment Assistance Program—was folded into the TAA Program in 2002.

Looking Inward

The NAFTA governments are seeking to build on the accomplishments of the past decade to improve the fluidity of regional cross-border economic activity. Four priorities relevant to agricultural trade are: (1) regulatory cooperation; (2) cross-border trucking; (3) dispute resolution mechanisms in the North American produce market; and (4) NAFTA's rules of origin.

Regulatory cooperation: The NAFTA governments are continuing efforts to harmonize sanitary, phytosanitary, and other regulations. Three bilateral initiatives—the High-Level Regulatory Cooperation Council (U.S.-Mexico), the Beyond the Border Working Group (U.S.-Canada), and the Regulatory Cooperation Council (U.S.-Canada)—frame some of the efforts underway to simplify and coordinate trade regulations among the NAFTA partners.

Previous examples of regulatory cooperation include:

- A "terms of reference" document signed in 2010 that outlines matters of equivalence (when a country recognizes another country's regulations as achieving the same level of protection as its own, even when the two countries' regulations are not identical), audit procedures, eligibility for exporting establishments, and communication channels between USDA's Food Safety and Inspection Service and Mexico's Servicio Nacional de Sanidad, Inocuidad, y Calidad Agroalimentaria (SENASICA);
- Enlistment of the North American Plant Protection Organization (NAPPO)—a forum in which the public and private sectors of the NAFTA countries work together on crafting science-based standards for protecting plant resources from regulated pests—to resolve some phytosanitary disputes; and
- The sharing of scientific studies and administrative evaluations among pesticide regulators and scientists in each NAFTA country.

Also, it is important to note that the United States is engaged in many other efforts toward greater regulatory coordination with its other agricultural trading partners.

Cross-border trucking: Restrictions on cross-border trucking continue to impede the smooth flow of agricultural products among the NAFTA countries. In July 2011, the U.S. and Mexican Governments agreed to establish a reciprocal, phased-in program that will authorize both Mexican and U.S. carriers to engage in cross-border, long-haul trucking operations. As part of this agreement, Mexico reduced by half the retaliatory tariffs on selected agricultural and nonagricultural products that it had imposed in retaliation for U.S. noncompliance with NAFTA's trucking provisions after the United States canceled a demonstration project for implementing these provisions.

When NAFTA was signed in 1992, the United States and Mexico agreed to allow persons from the other country to obtain operating authority to provide trucking services of this type by the year 2000, but the implementation of these provisions was seriously delayed. Currently, U.S. and Mexican truckers are required to transfer their trailers to short-haul drayage trucks located near the border, which then cross the border and deliver the trailers to other long-haul truckers on the opposite side. Cross-border, long-haul trucking operations are expected to lower shipping costs and shorten transit times associated with trucking cargo between the two countries.

Dispute resolution: The U.S. Government and the U.S. and Canadian private sectors have expressed their desire for the enactment of Canadian legislation that would protect produce suppliers from buyers that default on their payment obligations, something akin to the protections afforded by the Perishable Agricultural Commodities Act in the United States. Canada lacks a statute of this type, and the Canadian Government has commissioned a legal study to determine how such legislation would affect other Federal and Provincial laws already on the books.

NAFTA's rules of origin: The NAFTA governments are fine-tuning the agreement's rules of origin in order

Steven Zahniser, USDA/ERS

to facilitate trade. In a preferential trade agreement such as NAFTA, rules of origin determine whether a product originated in one of the countries covered by the agreement and thus whether that product qualifies for a preferential tariff, usually duty-free status in NAFTA's case.

Since 2003, the NAFTA Working Group on Rules of Origin (WGRO) has crafted four rounds of incremental changes to the accord's rules of origin that have been implemented by the NAFTA governments. Some of these changes directly apply to agriculture. For instance, modifications issued in 2009 allow for certain crushed or ground spices produced in the NAFTA region to qualify for duty-free status even when they were derived from spices (not crushed or ground) sourced outside the NAFTA region. In January 2011, the NAFTA Free Trade Commission instructed the WGRO to begin implementation of the fourth round of changes to the agreement's rules of origin and to consider the possibility of a fifth round.

Issues Separate From NAFTA Also Affect Agriculture

The fluidity of intra-NAFTA trade is affected by issues such as border security and immigration policy that are completely separate from the agreement. Complying with border security requirements sometimes creates challenges for companies participating in regional agricultural trade. According to a survey conducted by Taketo Murata in 2010 of 80 major Canadian firms that export food to the United States, 70 encountered higher costs in complying with the enhanced security measures following September 11, 2001, and 17 were unable to provide the same level of customer service as before. Despite challenges, 60 of the 80 surveyed firms indicated that their exports to the United States increased during the first decade of the 21st century.

Heightened security concerns over the past several years along the U.S.-Mexico border have complicated the inspection of live animal imports into the United States. In response, USDA's Animal and Plant Health Inspection Service and Mexico's SENASICA rerouted imports to different ports of entry and established temporary inspection points on the U.S. side of the border.

Cooperation by the NAFTA governments on security issues can energize efforts to work together on regulatory issues that affect regional agricultural trade. For instance, the Beyond the Border initiative with Canada, which has a prominent focus on security, includes activities related to livestock and animal product trade, and the High-Level Regulatory Cooperation Council with Mexico also contains a security component.

The desire to preserve national sovereignty, however, can conflict with efforts to improve the functioning of border institutions. The U.S. and Canadian Governments, for example, spent several years attempting to negotiate an agreement to move the cramped U.S. border inspection facility located on the Buffalo, NY, side of the Peace Bridge to a more spacious location on the Canadian side of the bridge. (The Buffalo, NY, Customs District accounted for 17 percent of U.S. agricultural imports from Canada in 2010.) These negotiations were abandoned in 2007 after the two sides failed to resolve a number of issues related to national sovereignty.

Further regulatory cooperation, institution of cross-border trucking between the United States and Mexico, improved dispute resolution mechanisms for produce marketers, and additional adjustments to NAFTA's rules of origin may reduce transaction costs and lower the risks associated with regional agricultural trade. This would allow producers, marketers, and consumers in each NAFTA country to respond more efficiently to market signals. While greater clarity in economic signaling in itself does not provide answers to the region's future challenges, it can provide a setting for better decisionmaking and a possible foundation for greater prosperity during the next two decades of regional free trade in North America and beyond.

This article is drawn from . . .

NAFTA at 17: Full Implementation Leads to Increased Trade and Integration, by Steven Zahniser and Andrew Roe, WRS-1101, USDA, Economic Research Service, March 2011, available at: www.ers.usda.gov/publications/wrs1101/

Food Spending in American Households, 2003-04, by Noel Blissard and Hayden Stewart, EIB-23, USDA Economic Research Service, March 2007, available at: www.ers.usda.gov/publications/eib23/

Local Foods Marketing Channels Encompass a Wide Range of Producers

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- When intermediated sales (locally grown food sold to a grocery store, restaurant, or distributor) are combined with farmers' direct-to-consumer sales, the size of the U.S. local food market was $4.8 billion in 2008.
- Local food marketing channels varied with farm size, region of the country, and proximity to population centers.
- Small and midsized farms with local food sales spent more hours farming, were more likely to list farming as the principal operator's primary occupation, and tended to forgo the opportunity to earn additional labor income more than similarly sized farms without local food sales.

Farmers selling locally grown food through farmers' markets, roadside stands, and other local food outlets account for a small, but growing, segment of U.S. agriculture. Consumer demand for locally produced food is driven by demand for freshness, support for the local economy, and personal communication with the producer (see "Varied Interests Drive Growing Popularity of Local Foods" in the December 2010 issue of *Amber Waves*).


FARM
FRESH
ZUCCHINI
BEANS
CHERRIES
POTATOES
FRESH
SWEET
CORN

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In addition to buying directly from farmers, consumers also purchase locally grown food through retail channels that enable consumers to purchase local foods with one-stop shopping convenience (see "Local Food Supply Chains Use Diverse Business Models To Satisfy Demand," in the December 2010 issue of *Amber Waves*).

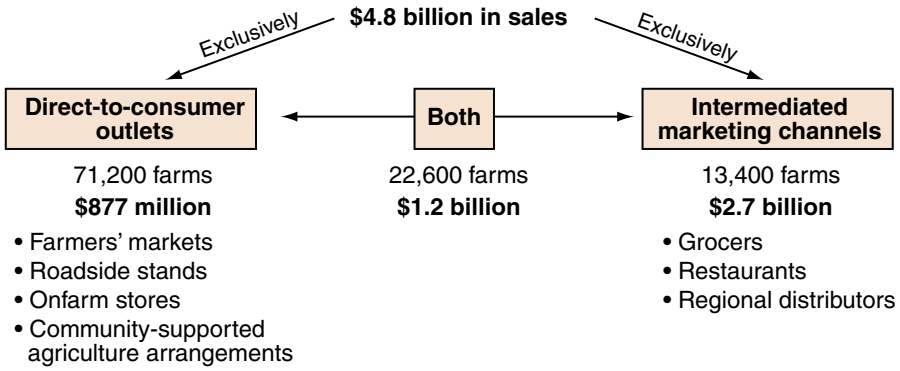
When intermediated, or indirect, local food marketing channels, such as sales through grocers, restaurants, and regional distributors, are combined with direct-to-consumer sales by farm operations, a more complete picture of the local food market emerges than is the case when only direct-to-consumer sales are considered.

Based on data from USDA's Agricultural Resource Management Survey (ARMS), local food sales amounted to $4.8 billion in 2008 when direct-to-consumer and intermediated sales of locally grown food are measured—four times higher than estimates based on direct-to-consumer sales alone. ERS researchers used these data to explore differences in the marketing channels used by farms selling locally, to examine the relationships between producer location and the marketing channels used, and to assess operators' commitments to farming among farms with and without local food sales.

Marketing Channels for Locally Grown Food

The 2008 ARMS measured local food sales by asking farm operators whether they sold directly to consumers at farmers' markets, roadside stands, onfarm stores, and community-supported agriculture or through intermediated sales to local grocers, restaurants, and regional distributors during the year. Over half of local food sales—$2.7 billion—were from farms selling local foods exclusively through intermediated marketing channels. Farms using both direct-to-consumer and intermediated marketing channels accounted for a quarter of local food sales ($1.2 billion).

Food sold indirectly accounted for most of the local foods market in 2008



Note: Community-supported agriculture arrangements link consumers with local producers.
Source: USDA, Economic Research Service based on data from USDA's 2008 Agricultural Resource Management Survey.

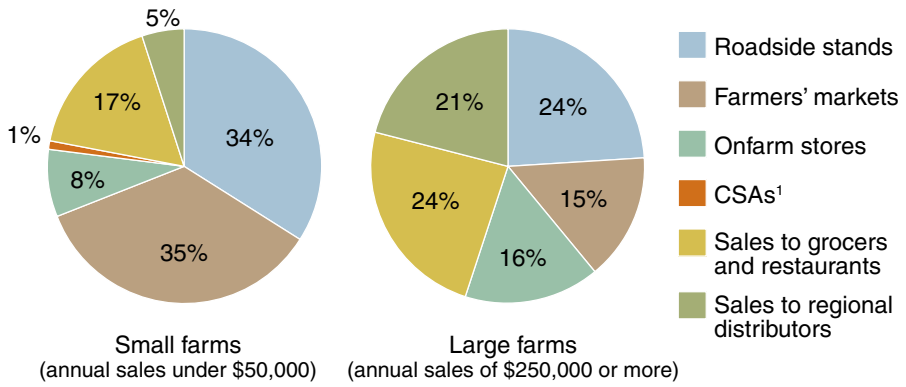
Use of local food marketing channels varied with farm size. Small farms (gross annual sales under $50,000) relied on direct-to-consumer channels more than large farms, which were more likely to use intermediated channels for their local food sales. Large farms (annual sales over $250,000) that market local foods exclusively through intermediated channels accounted for 92 percent of these intermediated sales, while small and medium-sized farms that market local foods exclusively through direct-to-consumer channels accounted for 73 percent of these sales.

While we do not have information on the value of local foods sold through individual marketing channels (such as farmers' markets or grocers), we do know the number of individual marketing channel types each producer used. Farmers' markets and roadside stands each accounted for over one-third of the local food marketing outlet types small farms used (35 and 34 percent, respectively). Farmers' markets and roadside stands were also used by large farms reporting local food sales (15 and 24 percent, respectively). Large farms, however, relied on regional distributors over four times more often than small farms to market their local food. Interestingly, grocers and restaurants, as a share of marketing channel types, were utilized by small and large farms selling locally at similar rates, suggesting that these marketing channels are available regardless of farm size.

Marketing Channel Use Varies With the Region of the Country

Previous research found that direct-to-consumer sales are highest in metropolitan areas (see "Urban Areas Prove Profitable for Farmers Selling Directly to Consumers" in the September 2010 issue of *Amber Waves*), and this finding also holds for intermediated sales of locally grown food. While farms that reported local food

Small farms rely on direct-to-consumer marketing channels more than do large farms



[1]CSAs are community-supported agriculture organizations that link consumers with local producers.
Source: USDA, Economic Research Service based on data from USDA's 2008 Agricultural Resource Management Survey.

sales in 2008 were more likely to be located in metropolitan counties, the rate varied among regions. The Northeast and the West Coast regions had the highest local food sales, but the regions differed with respect to the marketing channels used.

Farms with both direct-to-consumer and intermediated local food sales on the West Coast (California, Oregon, and Washington) accounted for less than 8 percent of all U.S. farms reporting local food sales but were responsible for nearly 24 percent of the value of U.S. local food sales. In 2008, 85 percent of the value of West Coast local food sales occurred through intermediated channels. The dominance of intermediated marketing channels among West Coast local food farms is likely because these farms are typically larger and located farther from metro areas than farms in other regions, necessitating the use of intermediated rather than direct-to-consumer marketing channels. High levels of local food production on the West Coast may also be related to the region's suitability for fruit and vegetable production. Recognized for its varied climates, long growing season, and extensive irrigation networks, the West Coast produces 56 percent of the Nation's vegetables, fruit and nuts, and other specialty crops.

In the Northeast, farms reporting local food sales tended to be smaller, located closer to densely populated urban markets, and more likely to use direct-to-consumer marketing outlets than their counterparts on the West Coast.

Vegetable, fruit, and nut farms dominate local food sales when compared with other types of farms. An examination of the factors driving spatial location differences finds that climate and topography favoring the production of fruit and vegetables, proximity to and neighboring farm participation in farmers' markets, and good transportation and information access drive direct-to-consumer sales.

Farm Operators Involved in Local Food Sales Differ From Those That Do Not Sell Food Locally

Farm households selling locally earned, on average, 17 percent less off-farm labor income than the average farm household not engaged in local food sales,

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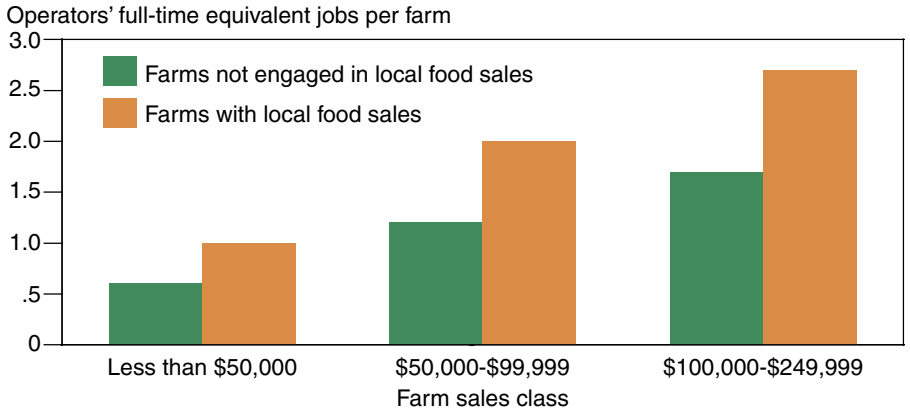
suggesting these farmers are willing to forgo the opportunity to earn additional household income off the farm in order to grow and sell foods locally. In addition, almost two-thirds of local food producers reported that local food sales accounted for at least 75 percent of their total farm sales in 2008, suggesting the importance of local food sales to gross sales for these farms.

Farms reporting local food sales require more operator time than do farms without local food sales. The average farm operator with local food sales devoted 1.3 full-time equivalent (FTE) jobs (1 FTE job equals 2,000 hours worked annually) to the farm, compared with 0.9 FTE job for farm operators without local food sales. This pattern held across farm sizes up to $250,000 in annual sales, as multiple members of the farm household may work as operators. For large farms above this sales level, there was no difference between the FTE operators on farms with and without local food sales. Since the operators of large farms often market local food through intermediated channels, they may not face the same degree of labor intensity as operators selling directly to consumers.

Small and midsized farms with local food sales were more likely to consider farming as the principal operator's primary occupation than comparably sized farms without local food sales. Overall, farm operators selling locally were 30 percent more likely than other operators to list their primary occupation as farming; small-farm operators selling food locally were 50 percent more likely to do so. As with FTE requirements, the difference in stated primary occupation between farms selling locally and those that do not disappears among operators of large farms.

Operators of small and midsized farms selling locally put in more hours working onfarm than operators who do not have local food sales



Note: A full-time equivalent job equals 2,000 hours worked annually.
Source: USDA, Economic Research Service based on data from USDA's 2008 Agricultural Resource Management Survey.

This article is drawn from . . .

Direct and Intermediated Marketing of Local Food in the United States, by Sarah A. Low and Stephen Vogel, ERR-128, USDA, Economic Research Service, November 2011, available at: www.ers.usda.gov/publications/err128/

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U.S. Food Safety Policy Enters a New Era

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- In late 2010, Congress passed the Food Safety Modernization Act (FSMA), the most comprehensive reforms to Federal food safety laws since 1938.
- The farm-to-fork, preventive approach embodied in the Act reflects an established scientific/managerial consensus on how to improve food safety systems.
- Economic research on similar food safety initiatives by industry and government can help guide implementation of the FSMA.

FDA

The 2011 Food Safety Modernization Act has implications across the entire food system, from the farmer to the food retailer.

A series of highly visible foodborne illness outbreaks in recent years helped create the political momentum to pass the most extensive reform of the Food and Drug Administration's (FDA) food safety authority since 1938. The Food Safety Modernization Act (FSMA), signed into law in January 2011, reflects a systematic approach to food safety management shaped by science, industry, and government over the past two decades. As FDA's Deputy Commissioner recently explained, the FSMA shifts the focus of FDA activities from "catching food safety problems after the fact to systematically building in prudent preventive measures across the food system, from the farm to the table."

While the FSMA directly affects only FDA authority, its implementing regulations and policies are likely to influence food safety practices throughout the Federal Government and the food and farm sectors. More efficient regulation could reduce the burden of new programs on producers and consumers while helping to ensure that food safety goals are met. ERS research conducted over the past two decades provides a number of lessons that can help identify efficient and effective means of implementing the Act.

Markets and Lawsuits Alone Provide Insufficient Safeguards

Each year, roughly 1 in 6 Americans—47.8 million people—get a foodborne illness. Most of these illnesses are mild and resolve in a matter of days. But many result in chronic, even lifelong, outcomes, including kidney disease, arthritis, and digestive disorders. About 128,000 people per year are hospitalized from these illnesses; 3,000 die. While the chances of getting ill from any particular meal are very small, foodborne sources cause as many illnesses and deaths as the flu in a typical year.

Providing food safety is not free. In an unregulated market, firms cannot afford to invest in safety if buyers are not able to distinguish between the safety of competing products and are not willing to pay a premium for the safer offering. Unfortunately, the safety of food products is usually unobservable to consumers, and often even to companies in the food industry.

Because consumers cannot directly observe food safety, retail markets will generally undersupply it. But there are other places in the supply chain where market incentives help ensure food safety. Major recalls or other food safety failures are more likely to harm companies with significant brand equity, particularly those involved in retail sales. To protect themselves, some companies—particularly national restaurant chains and suppliers of branded meats—have set up supply contracts that specify safety standards or reward use of innovative technologies to improve safety. But such firms supply only a portion of the Nation's food.

Some see liability suits as a major driver for firms to invest in food safety. ERS research shows that jury awards in personal injury suits offer limited incentives. The nature of foodborne illnesses makes the likelihood low of identifying what food and which producer caused injury. Plaintiffs were found to be most likely to win if they could link their illnesses to a specific pathogen or a large outbreak. Yet, Centers for Disease Control and Prevention (CDC) epidemiological studies can identify the pathogen source for only 20 percent of U.S. foodborne illnesses in a typical year. Less than 1 percent of foodborne illnesses are part of an outbreak.

New Act Better Aligns FDA Programs With Recognized Food Safety Principles

The FSMA builds on efforts to modernize the U.S. food safety system that began in the early 1980s. This modernization movement emphasizes the efficient use of both public and private resources as reflected in a shift from inspection and outbreak response to prevention and the use of flexible, risk-based management practices.

Key elements in the FSMA include:

- Requirements for food processors to analyze food safety hazards and implement risk-based preventive controls;
- Mandatory FDA recall authority with greater public outreach;
- Enhanced traceability systems for food products;
- Improved disease surveillance and use of science-based risk assessments to target FDA activities;
- Onfarm safety standards for produce; and
- Redesign of FDA's import safety control system by coupling third-party certification and private-sector verification with FDA inspection of foreign food facilities.

ERS research has examined a broad range of food industry and consumer behavior issues related to food safety. This article focuses on the first four key elements. This research can help inform FDA's implementation of the FSMA.

Managerial Flexibility Critical to Risk-Based Controls

The FSMA focuses on prevention of food contamination as the first line of defense against food safety hazards. The Act requires that virtually all food processors, manufacturers, and packers analyze hazards and adopt risk-based preventive controls to manage product safety. Prior to the Act, such preventive controls were only required for juice, seafood, meat, and poultry under Hazard Analysis and Critical Control Points (HACCP) regulations, though many other firms follow its principles in their operations.

HACCP is a quality management system that looks at the operation as a whole. In an HACCP plan, firms must identify potential food safety hazards and where they might arise in their operation. Firms then must develop plans for monitoring these "critical control points" and responding if hazards are detected. HACCP plans also require a recordkeeping system to assist firms and inspectors in verifying that the system is under control. FDA is in the process of defining what will be required under the FSMA.

USDA's Food Safety and Inspection Service (FSIS) issued one of the first U.S. HACCP rules in 1996. ERS research on the meat and poultry industries' experience with these HACCP regulations may provide useful insights for FDA and industry. USDA's regulations kept some conventional proscriptive sanitation and process requirements, such as proper hand-washing procedures and temperature controls, in effect along with the new, more flexible HACCP requirements.

Based on results from a 2002 nationwide survey and FSIS *Salmonella* product testing data, ERS researchers found that conventional proscriptive requirements were responsible for only a third of the decrease in positive pathogen test samples. Managerial decisions to invest in human and physical capital, food safety technology, and changes in firm organizational structure were responsible for the remainder.

These management decisions were influenced both by HACCP requirements and market forces. Nearly half the *Salmonella* reduction was tied to direct contractual relationships in which suppliers were paid a price premium, given a guaranteed quantity agreement, or provided other incentives for paying more attention to food safety. The study's results suggest that HACCP is a more effective means of improving food safety than conventional proscriptive requirements.

Concern about potential impacts on small firms played a large role in congressional debates over the FSMA. In the ERS study of USDA's HACCP rules, small plants producing specialty meat products had higher average HACCP-related costs than large plants producing commodity products. However, the study suggests that the costs to small firms would have been even higher if FSIS had specified fixed expenditures rather than allowed plants flexibility in creating their own HACCP plans.

To protect their customers and their sales, many companies use supply contracts that specify food safety standards.

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Recalls and Public Notification Prevent Illnesses With Limited Industry Impact

Even with the best prevention efforts, food sometimes becomes contaminated. Recalls and consumer notification are important tools to prevent illness once contamination has occurred. They also help ensure that the responsible firms bear more of the cost of failing to prevent contamination than they otherwise would.

The FSMA enhances FDA's power to respond to problems when contamination occurs in three ways. First, the Act gives FDA mandatory recall authority. Currently, FDA cannot require a recall, though firms generally do so voluntarily when requested by FDA. The second, and more significant, change is that new provisions make it easier for FDA to detain products may violate food safety law or to suspend a facility's registration, thus preventing it from legally distributing food. Third, under the FSMA, FDA will develop standards for displaying information about recalls both on the Internet and in grocery stores.

Under an HACCP food safety plan, firms must identify where safety problems could occur, monitor these problem points, and take action if hazards are detected.


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The financial impact of recalls and consumer notification on businesses that do not produce contaminated products depends on the information consumers receive and how they respond. ERS research on the sales impacts of major food safety incidents over the past 10 years suggests that consumers have responded to recalls and outbreaks in a measured way that has limited spillover effects. In the cases studied, sales dropped significantly for a few weeks following the incidents, though in some cases a small decline in demand continued for as much as 8 months.

Traceability Systems Need To Vary by Product

For recalls to be effective, firms need to be able to trace product distribution. Traceability systems are also crucial to speedy identification of the source of contamination in CDC outbreak investigations. The FSMA directs FDA to establish pilot programs to evaluate alternative methods of tracing at least three different types of foods. Based on knowledge gained from these pilot programs, FDA will develop rules to improve product tracing systems for most of the U.S. food supply, building on and enhancing existing systems.

In 2004, ERS researchers studied traceability systems for U.S. produce, cattle/beef, and grain and oilseeds. They found the diverse characteristics of the three commodities—the perishability of produce; the need to prevent theft and credibly assert livestock breeding lineage; and the ability to blend, grade, and store grain—led to the development of very different traceability systems in the three sectors.

Three broad conclusions can be drawn from this research. First, uniform systems applied across all sectors of the food industry are likely to be more costly and less effective than ones that recognize the unique characteristics of different sectors. Second, government-mandated traceability systems need to allow firms flexibility to adjust to changing technology and changing consumer demand. Third, the private sector has been successful in developing traceability systems that meet private-market needs, even evolving new organizational structures, like contracts, cooperatives, and vertical integration to facilitate traceability. But, markets have not been as effective in encouraging traceability that meets public needs related to food safety.

A Narrow Range of Pathogens and Foods Cause Most of the Harm From Foodborne Illness

The FSMA greatly increases FDA responsibilities for food safety and mandates more frequent inspections. The Act directs FDA to use risk-based prioritization to target efforts toward the most serious foodborne health hazards. FDA is expecting to look at factors such as firms' and importing countries' past food safety records, indicators of a firm's financial stability, the inherent riskiness of foods, and most critically, the relative contribution of different foods to the total burden of foodborne illness in the United States.

Comparing the illness burden of different pathogens and food sources is not easy. CDC can only identify the responsible pathogen in 20 percent of foodborne illness cases overall, though CDC can identify the pathogen for 44 percent of cases that send people to the hospital or result in death.


PhotoDisc

FDA will study existing traceability systems to develop rules to improve the ability of companies to trace the distribution of their products.

And, cases with different outcomes are not directly comparable. Some pathogens cause many mild illnesses. Others cause fewer illnesses but fatal outcomes or serious chronic conditions.

Health economists have developed two aggregate measures to facilitate comparison of health burden across diverse diseases: monetary measures and a measure called a quality-adjusted life year (QALY). The cost of illness—typically measured as treatment costs plus the value of lost time from work and individuals' willingness to pay to reduce risk of death—is usually used as a monetary metric in food safety policy analysis, even though it underestimates the burden of illness.

The QALY approach allows patients, medical experts, or a sample of the general population to rank the relative impact of illnesses on the quality of life. This measure was developed to help health care analysts and doctors evaluate the cost effectiveness of alternative medical treatments. The Office of Management and Budget recently allowed the QALY approach to be used in regulatory analysis.

Researchers at ERS conducted some of the earliest studies of the economic costs of foodborne illness. ERS's online Foodborne Illness Cost Calculator provides a transparent framework for estimating the cost associated with foodborne illness due to *Salmonella* and STEC:O157 (formerly *E.coli*: O157:H7). This work is ongoing. As patterns of disease, detection, and treatment change, the public health and economic burden also changes.

Building on earlier ERS cost-of-illness models, a team of researchers from the University of Florida and ERS recently estimated that 14 pathogens impose a little over $14 billion annually in cost of illness and cause a loss of about 61,000 QALYs each year. These pathogens account for over 95 percent of the foodborne illnesses, hospitalizations, and deaths CDC can tie to specific pathogens. This study also estimates the share of foodborne illnesses attributable to consumption of 10 broad food categories such as beef, poultry, or produce.

The results suggest that it should be possible to target public and private food safety control efforts to reduce illnesses more effectively. Just 5 pathogens account for 90 percent of the cost of foodborne illness from these 14 pathogens. Ten food/pathogen combinations are responsible for almost 60 percent of the public health burden of the 14 pathogens, whether measured by cost of illness or QALYs.

The FSMA is a major change in FDA legal authority aimed at bringing FDA's food safety programs more in line with recognized food safety management principles. But it is *not* a major change in the scientific consensus about the direction food safety management needs to move. Many of the policies FDA will be implementing—like prioritizing risk and encouraging producer initiative—are already in use elsewhere. Research by ERS and other institutions on the design and impacts of past regulatory efforts can inform policymakers as they move forward.

This article is drawn from . . .

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Changing Farming Practices Accompany Major Shifts in Farm Structure

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- **Over the past three decades, the number of farming operations has remained relatively steady, but production has shifted to larger farms.**
- **Changes in production and marketing practices have facilitated—and have been facilitated by—organizational and distributional changes in agricultural production.**
- **Resulting changes in agricultural productivity helped keep prices for agricultural goods relatively low and reduced the environmental footprint for each unit of agricultural output produced, but not without tradeoffs.**

Bruce Fritz, USDA/ARS

For the past three decades, the number of U.S. farms has remained fairly stable at about 2.2 million, while the amount of farmland declined about 8 percent between 1982 and 2007. However, this relative stability masks major shifts in the distribution of production and significant growth in the amount of goods and services produced by the agricultural sector. The number of very large farms (those with over $500,000 in inflation-adjusted annual sales) has grown (see box, "Concentration of Agricultural Production Has Increased Since 1987"). Large farms' share of agricultural production has increased, while the number and market share of all other farms except for the smallest (those with annual sales under $10,000) has declined (see "U.S. Farm Structure: Declining—But Persistent—Small Commercial Farms" in the September 2010 issue of *Amber Waves*).

Concentration of Agricultural Production Has Increased Since 1987

Because of the large and growing number of small farms in the U.S. that produce very little in a typical year, statistics on the average level of production per farm may not be very informative. For many commodities, the number of both very large and very small farms is growing—a fact obscured by relatively steady average production levels. A clearer picture of the increasing concentration of production on larger farms can be seen by looking at the farm size for which half of all acres harvested (or animals raised) are on larger farms and half are on smaller farms, referred to as the mid-aggregate enterprise size. For example, in 1987, half of all hogs were produced on farms that sold 1,200 head or more. By 2007, half of all hogs sold were from farms that produced 30,000 head or more—an increase of 2,400 percent over 20 years. While the increasing concentration of hog production on larger farms may be an extreme example, increasing mid-aggregate sizes were also observed for other livestock and poultry products, all the major field crops, and many other commodities.

Mid-aggregate enterprise sizes show dramatic changes in who produces most commodities

Selected commodity	Census year					Change, 1987 to 2007
	1987	1992	1997	2002	2007	
	Head per farm					*Percent*
Animal products[1]						
Broilers	300,000	384,000	480,000	520,000	681,600	127
Hogs	1,200	1,880	11,000	23,400	30,000	2,400
Fattened cattle	17,532	23,891	38,000	34,494	35,000	100
Dairy production	80	100	140	275	570	613
	Acres harvested per farm					*Percent*
Field crops						
Corn	200	300	350	450	600	200
Soybeans	243	300	380	480	490	102
Wheat	404	562	693	784	910	125
Cotton	450	605	800	920	1,090	142
Rice	295	400	494	607	700	137

[1]Half of all animals sold came from farms selling more than the mid-aggregate, and half came from farms selling less. Half of all dairy cows were on farms with larger herds than the mid-aggregate, and half were on farms with smaller herds. For crops, half of harvested acres were from farms with more than the mid-aggregate acreage, and half were from farms with smaller acreage.

Source: USDA, Economic Research Service, compiled from Census of Agriculture data.

At the same time, U.S. agricultural output has continued to grow rapidly, even as the amount of land and labor devoted to farming has declined (see "Is U.S. Agricultural Productivity Growth Slowing?" in the September 2010 issue of *Amber Waves*). In response to changing market conditions, technologies, public policies, and a host of other factors, farmers, particularly those operating larger commercial-sized farms, have adjusted production practices in numerous ways to remain competitive.

U.S agriculture provides food and fiber for growing domestic and international markets, supplies the feedstock for an expanding bioenergy sector, and provides ecosystem services such as carbon sequestration to a nation increasingly concerned with the environment. Without the productivity growth embodied in more advanced farming practices, meeting the increased demand for agricultural goods and services would require expanded use of marginal land, thereby raising the cost of agricultural production, both in terms of market prices and environmental degradation.

Nonetheless, changing farming practices can have both positive and negative effects. For example, the introduction of genetically engineered (GE) seeds, wider adoption of irrigation, and growth in contract sales have allowed farm operators to diminish the intensity of soil tillage, reduce weather-related risks, and lower production costs through increased specialization. But widespread adoption of GE plants is viewed with concern by some consumers, by farmers experiencing weed resistance to herbicides, and by nearby farmers specializing in organic crop production. Wider adoption of irrigation can reduce the availability of water for other uses and has implications for pesticide and fertilizer runoff. Increased contracting can leave some farmers worried about price fixing and can increase their risk if the contractor defaults. Moreover, the geographic consolidation of larger livestock operations has heightened localized concerns about the handling of manure and its environmental consequences.


AGCOcorp

Changing Practices Contribute to Larger Farms, Greater Use of Production Contracts

The increasing dominance of confined animal feeding operations for many types of livestock and a growing reliance on production contracts have contributed to the growth of large, specialized poultry, hog, and dairy operations. While confined animal operations are not new, their use in livestock farming has been increasing. Changes in the relative prices of land, labor, and capital over the past three decades may have encouraged the substitution of cheaper capital (in the form of more mechanized animal housing, feeding, and manure management facilities) for more expensive land and labor. Furthermore, capital-intensive operations often find that increases in farm size can lower the cost of production per animal, leading to consolidation of production on larger operations. In contrast, the labor and management requirements of operations that raise animals under less confined conditions limit the potential growth of such operations.

Historically, most agricultural products have been bought and sold for immediate delivery (through "spot markets"), but a growing share of U.S. farm output

is produced and sold under agricultural contracts that govern how and when commodities change hands. In 2008, contracts covered nearly 40 percent of the total value of agricultural production, up from 11 percent in 1969. Production contracts (where the contractor owns the commodity and pays the farm operator to raise it) are widely used in livestock production, while marketing contracts (where the farmer retains ownership of the commodity but promises future delivery to the contractor) are used for many crops.

Product differentiation, quality control, and the need to ensure a ready supply for processing facilities are key reasons why contractors prefer production and marketing contracts over spot markets. Production contracts are particularly prevalent in the poultry and hog sectors, accounting for 90 and 68 percent of production, respectively, in 2008.

Producers also enjoy multiple benefits from using contracts. Contracts allow them to focus on one production stage while not having to worry about other aspects of the agribusiness, such as marketing or feed formulation. This frees farm labor, enabling producers to increase production of the contracted commodity (that is, grow in size) or to diversify by growing other commodities or pursuing off-farm work. Moreover, producers with contracts enjoy better access to capital markets, allowing them to carry more debt—and therefore more capital—given their net worth than producers without contracts. Additionally, contracts ensure an outlet for their product and reduce or eliminate price risk for both the farm's output and for farm inputs provided by the contractor.

Changes in marketing arrangements, like other technological developments, have had a pronounced impact on farm sector productivity and structure. By reducing price risk, rewarding contract farmers for increasing production efficiency, and allowing farmers to become more specialized, contract sales have encouraged increased capital investments on large farms and further consolidation of production. Depending on the terms of the contract, they can also encourage the adoption of certain farming practices (for example, by requiring more stringent food safety practices) and require that housing and equipment meet minimum specifications, thereby weeding out less efficient operators over time.

One example of the impact of production contracts on efficiency is the increasing feed conversion rate among hog producers. The average quantity of feed required per hundredweight of gain declined 44 percent for feeder-to-finish hog operations between 1992 and 2004. Most feeder-to-finish operations operate under production contracts. Since contractors typically bear the cost of supplying feeder pigs and feed to the farming operation, they have a strong incentive to invest in genetic improvements in the animals and improved formulations to reduce feed costs. And since contracts allow farmers to specialize in the grow-out phase of the production process, they have adopted practices that further increase feed efficiency, such as grouping pigs by age and weight so feed rations can be formulated for each pig's specific needs. In contrast,

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the average feed conversion rate on farrow-to-finish hog operations—which are less likely to have production contracts and are less specialized—declined by only 15 percent in 1992-2004.

While production contracts have boosted the productivity of livestock producers, they also limit a farm operator's management options and can leave farmers who are heavily invested in specialized housing and equipment dependent on a single buyer. The concentration of market power in the hands of one or two contractors—particularly for products with a short shelf-life or a limited geographic market—can handicap farmers in negotiations and magnify their risk from contractor default. And while feed conversion efficiency has reduced the amount of waste produced by each animal, the geographic concentration of production encouraged by contracts may have led to localized and intensified environmental risks in specific areas.

Labor-Saving Innovations Help Crop Farmers Expand Their Operations

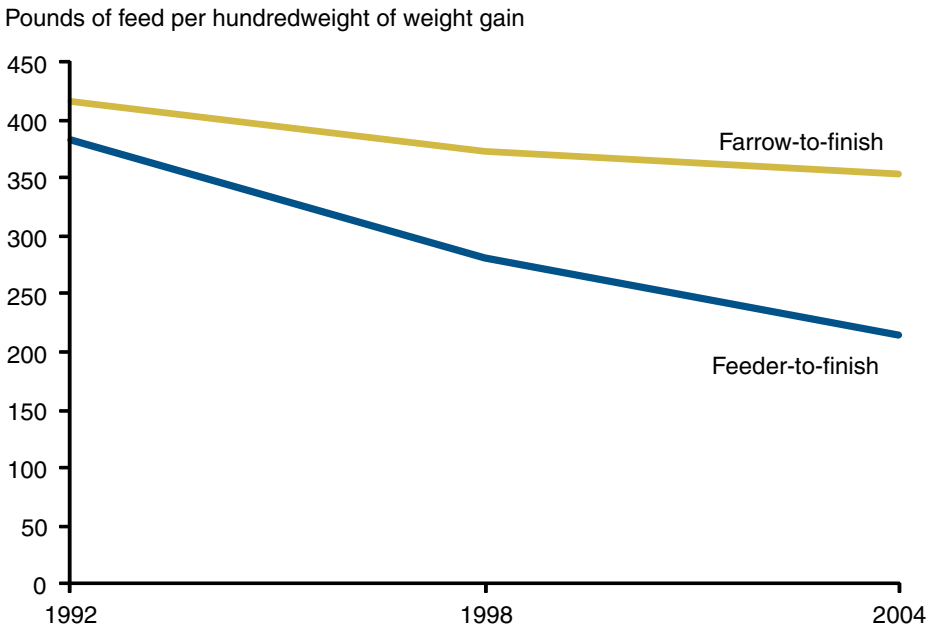
While agricultural contracts are less prevalent among crop farms, they are very important for specific commodities, such as sugar beets, tobacco, and peanuts, and their use has increased over time for most other commodities. When contracts are used in crop farming, they are almost always marketing contracts used by larger operations. But aside from their long-term impacts through reduced price risk, crop marketing contracts do not appear to provide the same push toward concentration that has occurred in the poultry and hog industries. To the extent that management time prevents crop farm operators from expanding their operations, other technological advances (such as improved equipment) that reduce management requirements can ease this constraint, enabling farmers to expand and consolidate.

Improved farm equipment has enabled farmers to increase the size of their crop farms. For example, in 1970, an operator could plant 40 acres of row crops and harvest 4,000 bushels per day. By 2005, a producer could plant 420 acres and harvest 30,000 bushels in a single day. Consolidation trends have continued through the adoption of further labor-saving innovations, such as GE seed varieties, which have improved the efficiency of crop farm management.

GE crops were introduced in 1996 and have been widely adopted by producers. GE crops include herbicide-tolerant (HT) crops and insect-resistant (Bt) crops. HT crops were developed to survive specific herbicides, particularly glyphosate, that previously would have destroyed the crop along with the targeted weeds. Insect-resistant crops contain the gene from the soil bacterium Bt (*Bacillus thuringiensis*) that produces a protein toxic to specific insects, protecting the plant from insect damage. Based on USDA survey data, GE crops accounted for 94 percent of U.S. soybean acreage, 90 percent of U.S. cotton acreage, and 88 percent of U.S. corn acreage in 2011.

According to ERS research, U.S. farmers are realizing economic benefits from adopting GE crops, including lower

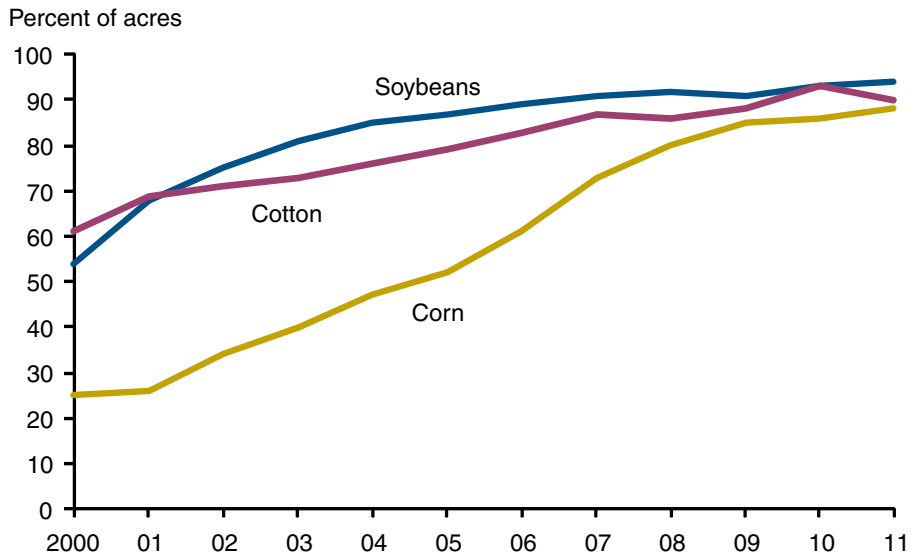
Feed conversion rates for hog operations have steadily risen, particularly for feeder-to-finish operations



Note: Farrow-to-finish operations are those on which pigs are farrowed (born on the farm) and then grown to a slaughter weight of 225-300 pounds. Feeder-to-finish operations are those on which feeder pigs (weighing 30 to 80 pounds) are obtained from outside the operation, either purchased or placed under contract, and then grown to a slaughter weight of 225-300 pounds.

Source: USDA, Economic Research Service using data from USDA's 1992 Farm Costs and Returns Survey and USDA's 1998 and 2004 Agricultural Resource Management Surveys.

Adoption of genetically engineered crops has increased dramatically since their introduction in 1996



Source: USDA, Economic Research Service, Adoption of Genetically Engineered Crops, available at: www.ers.usda.gov/data/biotechcrops/

pesticide costs, savings in management time, and, in many cases, higher yields through reduced losses to pests. And to the extent that GE crops lower the cost of production and increase yields, they put downward pressure on crop prices, which, over time, forces out the least efficient producers, encouraging further consolidation of farming resources and concentration of production.

The impacts of GE crops vary with the crop, technology, pest-infestation levels, and other factors. Overall pesticide use and/or pesticide toxicity is lower for adopters of GE crops, and the adoption of herbicide-tolerant crops may also indirectly benefit the environment by encouraging the adoption of less intensive tillage (how farmers prepare their soil for seeding and weed/pest control) practices. However, weed resistance to glyphosate has become a problem in some areas, particularly the South, and some contend that GE crops are not safe to eat (some European countries ban importation of GE commodities). Farmers marketing non-GE varieties also cite potential risks of "gene flow" from nearby fields planted to GE crops.

Farmers have a number of tillage options, including "conventional" or plow tillage and several types of "conservation" tillage—such as mulch till, ridge till, and no-till—that leave at least 30 percent of the soil covered by crop residue. Conservation tillage—particularly no-till—decreases soil erosion, increases water retention, reduces chemical runoff, and can shrink the carbon footprint of agriculture by lowering onfarm energy use and sequestering carbon within the soil.

Adoption of conservation tillage and a corresponding decline in conventional tillage has been stimulated by the prospects of higher economic returns and by public policies and programs promoting reduced tillage for its environmental benefits. As a result, conservation tillage has increased since 1989. Since this tillage option uses fewer resources to ready the land for planting, when coupled with herbicide-tolerant crops, the benefits of GE crops and conservation tillage reinforce each other. However, since conservation tillage does not eliminate pests, when coupled with non-GE crops, pesticide usage and management requirements may increase while potentially lowering crop yields.

Despite the benefits arising from the use of GE crops and conservation tillage, the concentration of production on larger crop farms still generates concerns about food safety, environmental degradation, and the structure of agriculture. This has created a demand for commodities produced using alternative production methods, such as organic farming (see box, "Growth of Organic Foods Markets").

Impacts on Productivity, Commodity Prices, and the Environment

The trend toward concentrated production on specialized operations, while a concern for some, has had economic benefits that should be weighed against potential costs. The changing farming practices discussed here, along with others such as wider use of irrigation and growing adoption of precision agriculture technologies (see "The Information Age and Adoption of Precision Agriculture" on page 8 of this issue), have allowed the farm sector to increase total output by nearly 50 percent over the past three decades, even as resources used in farming declined. These freed resources have been applied elsewhere, contributing to increased productivity throughout the economy. And consumers of farm products have benefited, too. Despite occasional price

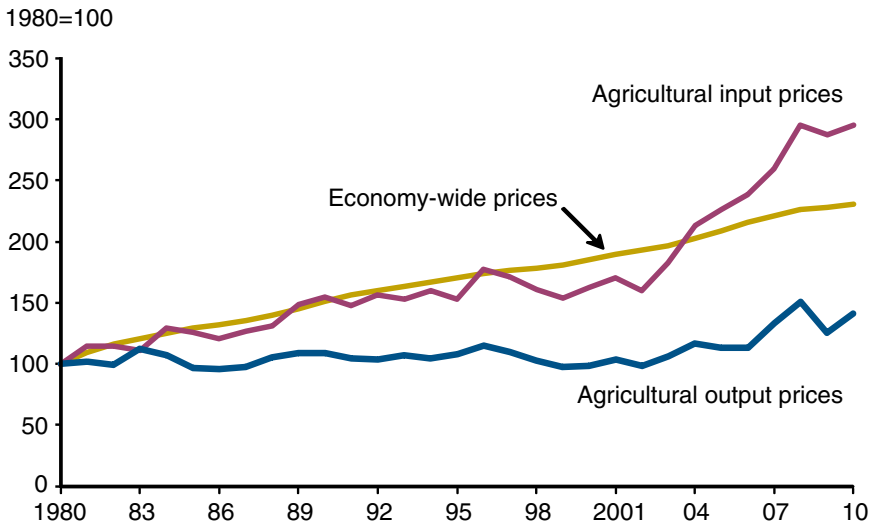
Growth of Organic Foods Markets

Not all the recent trends in farming practices have contributed to a concentration of production on larger farming operations. Due in part to consumer demand for pesticide-free foods, markets for organic products have grown, providing a profitable niche for farms of all sizes. USDA's organic regulations aim to ensure consumer confidence in the organic label and define organic agriculture as an ecological production system established to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. As a result, organic farming tends to be more labor intensive than conventional farming. While some larger farms produce organic products, thus far, organic production has been relatively more common among smaller farms whose operators consider themselves full-time farmers.

Once available only in natural food stores and farmers' markets, organic food has grown rapidly in terms of supply and demand over the past decade. By 2009, organic products accounted for over 3.5 percent of food sold for at-home consumption, with organic sales accounting for much higher percentages of specific commodities, particularly fruit and vegetables (see "America's Organic Farmers Face Issues and Opportunities" in the June 2010 issue of *Amber Waves*).

Organic production and other alternatives, such as locally grown food markets, satisfy consumers who perceive these foods as healthier, fresher, and produced sustainably on small farms. However, it does come at a higher price since GE crops and manufactured fertilizers, pesticides, and other chemicals (including antibiotics for livestock) often do not qualify as organic, making pest, weed, and disease control more difficult, time consuming, and costly.

High productivity growth has helped keep price increases for farm commodities relatively low



Source: USDA, Economic Research Service, using the Gross Domestic Product price deflator and data from USDA, National Agricultural Statistics Service, Prices Paid Index and the Bureau of Labor Statistics, Producer Price Index for Farm Products.

spikes and recent trends to the contrary, price increases for agricultural commodities have lagged far behind both economy-wide price increases and increases in prices of agricultural inputs over most of the last 30 years.

The combination of changes in farming practices, conservation program funding, and other structural trends have also resulted in environmental benefits, at least relative to the environmental consequences of producing today's output using the farming practices of the 1970s. Changes in practices like tillage and livestock feed efficiency, when coupled with efforts by farmers to improve nutrient and pest management (often with financial help from and prodding by various levels of government), have helped limit soil erosion and nutrient runoff. As a result, the environmental footprint for the average unit of agricultural output produced has shrunk.

This article is drawn from . . .

ERS Data on Agricultural Productivity in the United States, available at: www.ers.usda.gov/data/agproductivity/

ERS Briefing Room on Agricultural Chemicals and Production Technology, available at: www.ers.usda.gov/briefing/agchemicals/

ERS Briefing Room on Farm Structure, available at: www.ers.usda.gov/briefing/farmstructure/

You may also be interested in . . .

"Forces Affecting Change in Crop Production Agriculture," by Elizabeth Bechdol, Allan Gray, and Brent Gloy, *Choices Magazine*, Vol. 25, No. 4, (2010): 11-16

Can Brazil Meet the World's Growing Need for Ethanol?

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- Brazil is a major supplier of ethanol due to its natural advantage in sugarcane production, productivity gains in both sugarcane production and ethanol processing, and supportive government policies.
- Brazil has the potential to fill the growing world demand for ethanol based on its vast arable land area, robust productivity, and Brazilian ethanol's status as a low-carbon renewable fuel.
- However, Brazil's ability to supply the world ethanol market also depends on domestic ethanol demand; relative prices of ethanol, sugar, and crude oil; the exchange value of the Brazilian real; and improvements to infrastructure.

Worldwide production and use of ethanol as an alternative to fossil fuel has increased dramatically since 2000. Ethanol demand is being driven by rising world crude oil prices, increased use of ethanol as an environmentally friendly fuel oxygenate, and government incentives in many countries to reduce dependence on fossil fuel by increasing the use of renewable energy sources. Global ethanol use will continue to rise over the next decade if countries fulfill their ethanol use targets.

Brazil is the world's second largest ethanol producer and exporter (after the United States). Several factors have combined to stimulate the development of Brazil's ethanol industry: an increased capacity to produce sugarcane as an ethanol feedstock, supportive government policies, and improved efficiency in sugarcane production and ethanol conversion processes. But Brazil will need to sustain production growth in the ethanol sector in order to meet increasing domestic demand and maintain its export share.

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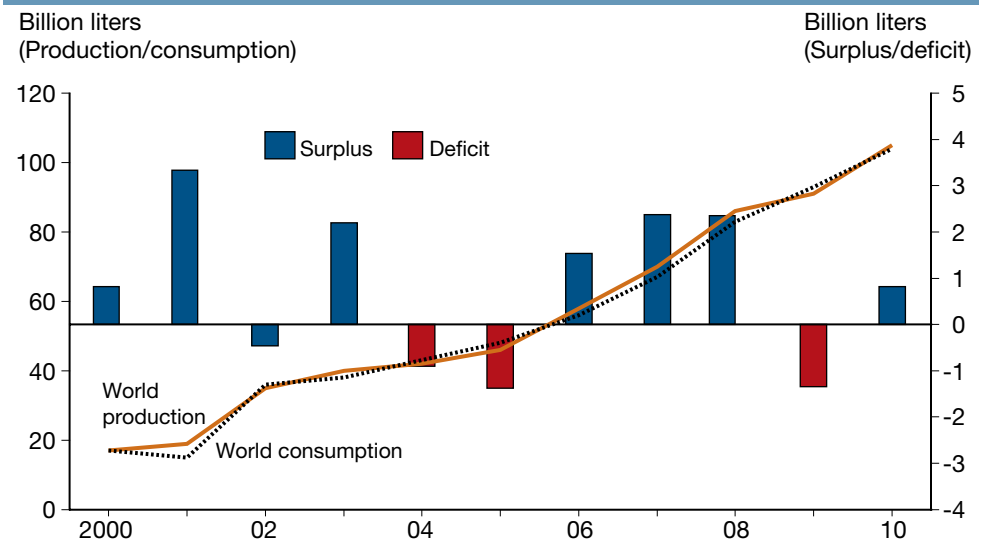
Brazil's Production of Sugarcane-Derived Ethanol Expanded Rapidly

Brazil is now the world's largest grower of sugarcane at 719 million tons in 2010, accounting for a third of world production. Cultivated sugarcane area has expanded rapidly from 4.3 million hectares (1 hectare = 2.47 acres) in 1990, to over 10 million hectares in 2010. Sugarcane cultivation has been central to Brazilian agricultural development since the 1950s. Sugar was Brazil's most valuable export crop in the 1950s and 1960s. In the mid-1970s, emphasis switched from sugar to ethanol production to meet domestic fuel needs, and, with the current boom in renewable fuels demand, Brazil has become a large-scale ethanol producer and exporter.

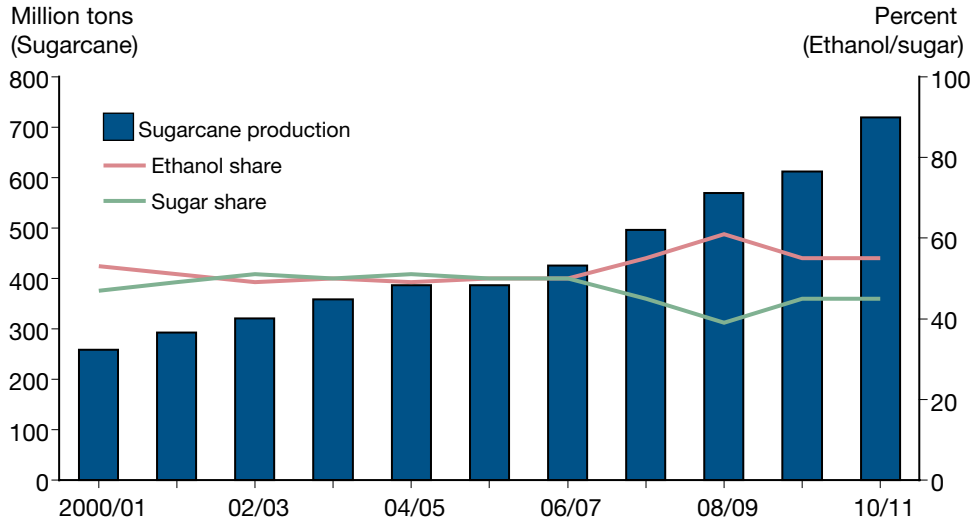
The rapid expansion in Brazil's sugarcane production is the result of a favorable climate, land availability, abundant labor, a pro-ethanol public policy, and research by public agencies to develop higher yielding cane varieties and new planting techniques to increase efficiency. While much of the expansion has been due to the conversion of former pastureland to sugarcane cultivation, with area increasing annually by 3.2 percent since 1975, productivity increases have also contributed to sugarcane growth. Continual improvements in sugarcane productivity since the 1970s have increased yields by almost 34 tons per hectare to the national average of nearly 80 tons per hectare in 2010, one of the world's highest. In

Global production and use of ethanol has increased dramatically since 2000



Source: USDA, Economic Research Service using data from the International Energy Agency and LMC International.

In 2010, over 55 percent of Brazil's sugarcane harvest was used for ethanol production



Source: USDA, Economic Research Service using data from Brazil's Ministry of Agriculture, Livestock and Food Supply.

São Paulo, Brazil's leading cane-producing State, yields are 20-25 percent above the national average.

In 2010, Brazilian sugarcane used for ethanol production totaled 398 million tons, or 55.4 percent of the sugarcane harvested. Domestic and global growth in ethanol demand has boosted the share of cane used for ethanol since 2006/07. The allocation of sugarcane to production of sugar versus ethanol is set by millers based on expected sugar and ethanol prices and market demand. This marks a significant change from the early years of *Proálcool* (Brazil's ethanol program), when the allocation of sugarcane to ethanol production was an administered policy instrument to counter oversupply of sugar and low international sugar prices.

Brazil's Ethanol Production Capacity Has Also Increased With Growing Number of Plants

Brazil's ethanol production capacity rose from 11 billion liters (1 liter = 0.26 gallon) in 2000 to 27 billion liters in 2010, accounting for 26 percent of worldwide ethanol production in that year. Brazil is now the second largest ethanol producer behind the United States. Since 2000, the number of ethanol-producing plants (distilleries and mixed sugar-ethanol processing mills) in Brazil has doubled to 430. Most are located in São Paulo (SP), which accounted for 58 percent of total Brazilian production in 2010.

Growth in ethanol production has been fastest in Brazil's Center-West region, where production has increased 15 percent yearly since 2001. This region includes the States of Goias (GO), Mato Grosso do Sul (MS), and Mato Grosso (MT), which together accounted for 16 percent of Brazil's ethanol production and where future ethanol expansion is expected to occur.

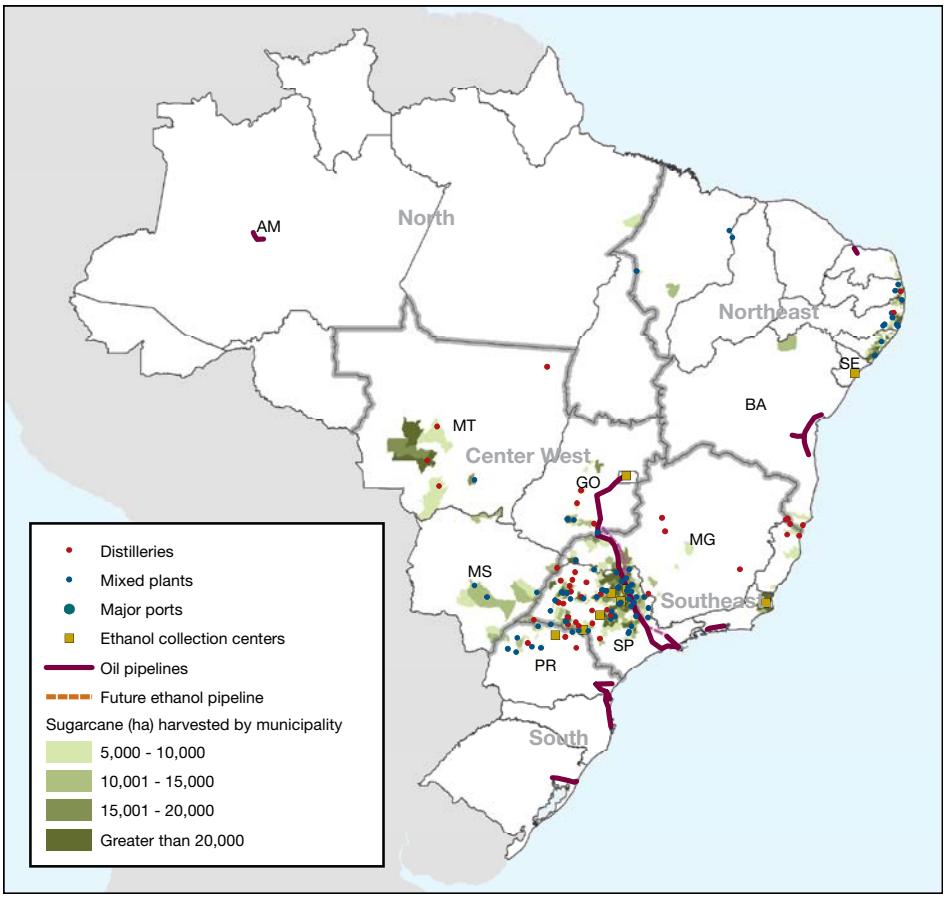
At the same time, processors are becoming more efficient in producing ethanol from sugarcane. Ethanol yields at distilleries have grown 4 percent per year since 2000 as plants have adopted more efficient processing technologies.

Brazil's position as an exporter of ethanol continues to grow in importance: the ratio of exports to production increased from an average of 4 percent in the early 2000s to 19 percent in 2008, before declining to 7 percent in 2010. Until 2008, Brazil was the world's largest supplier of ethanol, reaching a peak of 5.1 billion liters in 2008 and accounting for over 62 percent of the world ethanol export market. Brazil's ethanol exports declined in 2009 and 2010 because of strong domestic demand for ethanol and greater diversion of cane to sugar production in response to high global sugar prices and strong demand by India for sugar imports.

Government Policies Promote Brazil's Ethanol Production and Consumption

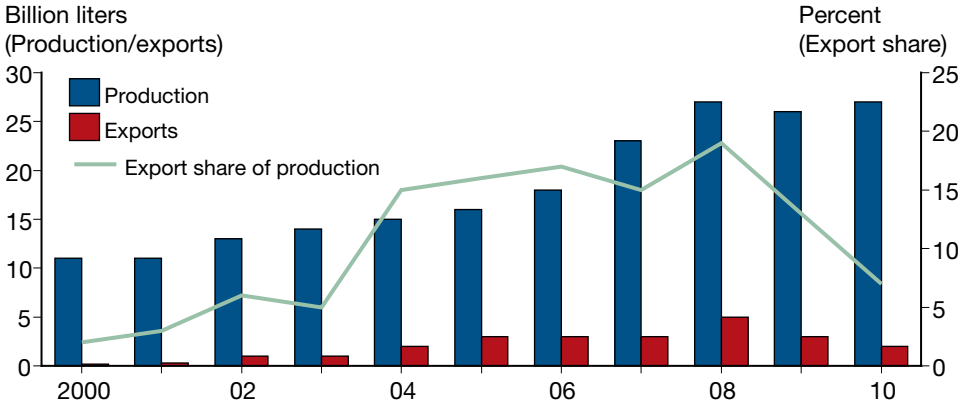
The push to promote Brazil's ethanol industry began in 1975 when the Government implemented the *Proálcool* program in response to soaring crude oil prices and a crisis in the international sugar market. The program encouraged replacement of imported crude oil with domestically produced ethanol, which was blended with gasoline. Under the program, the Government provided financial support for the construction of distilleries. To ensure a domestic market for ethanol, the Government stimulated demand through mandatory ethanol blending targets, subsidized credit to factories producing cars that use ethanol, and tax exemptions for consumers to buy them. Vehicles that ran only on ethanol were introduced in 1979, and by 2003, flex-fuel vehicles that can be powered by gasoline and ethanol in any proportion up to 100 percent ethanol were available. As in the U.S., support for consumption of ethanol

About 58 percent of Brazilian ethanol production occurred in São Paulo in 2010



Sources: USDA, Economic Research Service using data from Brazil's Ministry of Agriculture, Livestock and Food Supply and Brazil's National Petroleum, Natural Gas, and Biofuels Agency.

Brazil's ethanol exports fell after 2008 because of strong domestic demand and a greater diversion of cane to sugar production



Sources: USDA, Economic Research Service using data from Brazil's National Petroleum, Natural Gas, and Biofuels Agency, São Paulo Cane Agricultural Industry Union, and Global Trade Information Services.

continues through mandatory blending of ethanol with gasoline.

Credit granted by public financial institutions has also been an important factor in development of the sector. Government-subsidized credit allocated to sugarcane cultivation grew from less than $200 million in 2000 to $3.1 billion in 2010, while credit allocations to the ethanol industry expanded 80 percent per year since 2000 to $1.7 billion in 2010. Historically, sugarcane producers in Brazil's Northeastern region have been given special subsidies (currently R$5 per ton) and protection because of the region's weak economy and its dependence on sugar.

Demand for Ethanol Slated To Grow in Major Consuming Countries

Demand for ethanol in major consuming countries has risen rapidly. According to the International Energy Agency, world ethanol use increased by nearly 300 percent between 2000 and 2010, with consumption reaching over 104 billion liters. Global ethanol trade nearly doubled during the same period, but at 5.9 billion liters in 2010, world trade is still a small share of total use. World demand for ethanol is expected to continue to increase in response to anticipated economic growth, rising oil prices, and the mandates in many countries to replace fossil fuel use with renewable energy sources. Brazil is in a good position to satisfy demand: sugarcane-based ethanol is one of the most efficient sources of biofuel per hectare, with a yield in liters of ethanol per hectare that is almost double that of corn-based ethanol, according to USDA.

The U.S. and the European Union (EU) are two of the major consuming markets for Brazilian ethanol. The U.S. Energy Independence and Security Act (EISA) of

Shell Photographic Services, Shell International Ltd

2007 requires transportation fuel producers to use at least 136 billion liters of biofuels by 2022. The Renewable Fuel Standard (RFS) provision established under EISA mandates minimum use of 57 billion liters of corn-based ethanol by 2015, up from about 49 billion liters in 2010. The RFS also requires the use of at least 80 billion liters of cellulosic and advanced biofuels (which include ethanol from sugarcane and biodiesel) by 2022. The 54-cent per-gallon surcharge on imported ethanol is scheduled to expire at the end of 2011. If this happens, it may stimulate U.S. imports of Brazilian ethanol.

The EU's Renewable Energy Directive sets a mandatory minimum share of renewable energy in total fuel consumption in the transport sector of 10 percent per member state by 2020. While biodiesel is the principal biofuel used in Europe, the European Commission estimates that its ethanol consumption could rise from less than 5 billion liters in 2010 to about 10 billion liters by 2020. Several other importing countries, including Japan, have energy mandates that encourage the use of agriculture-based ethanol in their transportation sectors.

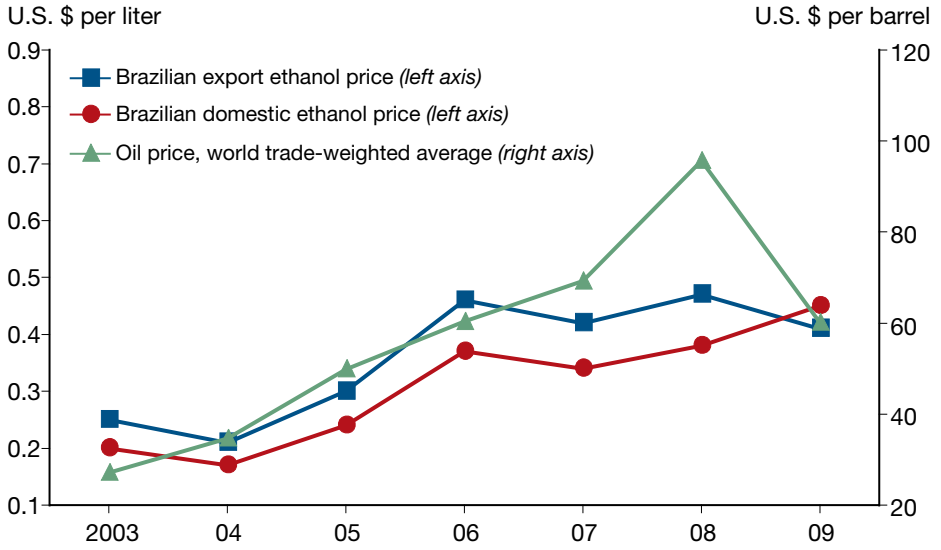
Brazil's Ability To Expand Ethanol Exports Uncertain

Global ethanol production, concentrated in only a few producing countries, may not keep pace with rapidly growing demand. Concerns about food and fuel tradeoffs may limit some countries' ability to increase ethanol production, particularly production of ethanol from grains. Based on USDA long-term projections, Brazil's ethanol production is expected to rise 45 percent during the coming decade to 43.8 billion liters by 2020. However, Brazil's ability to provide the bulk of the world's import needs will depend on its domestic ethanol demand, world sugar and oil prices, Brazil's currency exchange rate, and the capacity of its infrastructure to move ethanol to ports.

Growing domestic demand is certain to put pressure on Brazil's export supply. Brazil is the world's second largest ethanol consumer, behind the United States, and accounts for over 30 percent of global ethanol consumption. Brazil's domestic demand is projected to grow as sales of flex-fuel cars rise with increased income.

The world price of sugar is an important determinant of Brazilian ethanol supply. When the sugar price is high, more sugarcane is used for sugar; lower sugar prices favor conversion of sugarcane to ethanol. In 2009-10, drought in Brazil led to a smaller sugarcane harvest, declining stocks, and higher sugar import demand in major consuming countries such as India, China, and Pakistan. With higher international sugar prices, a larger share of the Brazilian sugarcane crop was allocated to sugar production. In late 2010, when the world sugar price fell to under 14 cents per pound from a 29-year high of 30 cents

Changes in the world price of oil affect the ethanol/gasoline price relationship in Brazil



Sources: USDA, Economic Research Service using data from Brazil's National Petroleum, Natural Gas, and Biofuels Agency, the International Energy Agency, and Global Trade Information Services.

per pound earlier that year, the share of sugarcane used for ethanol rebounded.

Although the ethanol blend requirement tends to insulate Brazil's domestic ethanol prices from fluctuations in world oil prices, changes in the world price of oil affect the ethanol/gasoline price relationship in Brazil. When oil prices fall, ethanol demand weakens. Conversely, higher world oil prices encourage increased use of ethanol in Brazil's rapidly expanding fleet of flex-fuel vehicles.

Both real (adjusted for inflation) and nominal exchange rates have enormous effects on Brazil's international competitiveness, export volumes, farm earnings, and processing margins for distilleries and sugar-ethanol processing mills. Brazil's currency, the real, appreciated in 2009, making Brazil's ethanol exports more expensive and reducing the competitiveness of Brazil's ethanol in the world market. Brazil's ethanol exports slipped to 3.3 billion liters in 2009 and to 1.9 billion liters in 2010.

Infrastructure Constraints Present Further Obstacles

Brazil faces considerable infrastructure and transportation constraints along its ethanol supply chain. The bulk of ethanol is transported from processing plants to collection centers and then to ports by truck. Adequate and modern road infrastructure is thus critical to maintain competitiveness in the industry. Poor roads impose even higher costs on farmers located in the Center-West frontier, where new distilleries are being established. The average distance from the Center-West region to export ports is over 600 miles.

Large investments in maintenance and expansion of road infrastructure are needed to keep up with the expected growth in demand and to lower delivery times and costs. Brazil's state-owned oil company, PETROBRAS, plans to start building two ethanol pipelines by 2012—a 715-mile-long pipeline from Goiás to the port of São Sebastião on the southeast coast and a 325-mile-long pipeline from Minas Gerais to the port in Rio de Janeiro. PETROBRAS estimates that the new pipelines, to be completed by 2016, will accommodate about 22 billion liters (doubling current transportation capacity) at about one-third the current cost of shipping ethanol by truck. The Government has allocated $4.6 billion for improvements in port infrastructure by 2016.

Can Brazil's Ethanol Industry Meet Global Demand?

Several factors favor the ability of Brazilian ethanol producers to increase production of ethanol from sugarcane and fill future global ethanol needs. Brazil has large areas of arable savannas that could be brought into production of sugarcane without risk of deforestation. Brazil's Ministry of Agriculture, Livestock and Food Supply estimates the scope for cropland expansion in Brazil at 119 million hectares, with 69 million hectares in savannas and 50 million hectares from pastureland conversion. According to USDA long-term projections, an additional 12 million hectares of Brazilian cropland will be brought into crop production over the next decade.

Technological advances to boost sugarcane yields per hectare and efficiency gains in producing ethanol from sugarcane seem assured given the new technologies being generated by the Brazilian Corporation for Agricultural Research. Brazil's current yields of 90-100 liters of ethanol per ton of sugarcane are projected to increase by an additional 80 percent over

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the next decade based on new technologies, including the use of crushed sugarcane stalks, or *bagasse*, for further processing of the sucrose content for ethanol. The Brazilian Economic Development Bank has allocated $22 billion for investments in 2011-14 to double the sector's production capacity over the next decade. Plans for new investments in the construction of new distilleries will provide an additional 18 billion liters of ethanol production capacity by 2020, according to UNICA (the Brazilian sugarcane industry association).

A number of other conditions will be necessary for Brazil to fulfill a large part of future global ethanol demand. Sugar and crude oil prices will need to remain at levels that will encourage increases in ethanol production beyond gains that can be realized through technological advances. Planned construction of pipelines and mill/port ethanol storage capacity investments must occur. The policy environment in which Brazil's ethanol industry operates will also have a major influence on future production and investment trends. The Brazilian Government announced in April 2011 that Brazil's National Petroleum Agency will regulate the chain of production of ethanol, including exports, to treat ethanol as a "strategic fuel" and no longer as an agricultural commodity, in an effort to provide a stable and reliable supply of ethanol. An easing of the Government-mandated fuel alcohol content in gasoline would result in increased Brazilian sugar production and exports.

This article is drawn from . . .

Brazil's Ethanol Industry: Looking Forward, by Constanza Valdes, BIO-02, USDA, Economic Research Service, June 2011, available at: www.ers.usda.gov/publications/bio02/

Mapping Food Deserts in the U.S.

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Some low-income communities in the United States lack stores that sell healthy and affordable food. The lack of store access in these communities—sometimes called food deserts—may contribute to poor diet, obesity, and other diet-related illness.

The U.S. Departments of Agriculture, Treasury, and Health and Human Services (HHS) are bringing together resources and expertise to support sustainable projects and strategies to eliminate food deserts. Private companies, local and tribal governments, and nonprofit organizations will be able to apply for Federal funds from these three Departments to implement strategies to increase access to healthy, affordable foods (www.apps.ams.usda.gov/fooddeserts/).

In support of these efforts, ERS analysts developed the Food Desert Locator—a mapping tool that presents a spatial overview of where food deserts are located and provides selected characteristics of the populations that live in them.

The Food Desert Locator complements ERS's Food Environment Atlas (www.ers.usda.gov/foodatlas/), which provides county- and State-level statistics on over 100 indicators of food choices, health and well-being, and community characteristics for all counties in the United States.

What Is a Food Desert?

There are many ways to define a food desert or to measure access to food. ERS's Food Desert Locator is based on a definition developed by USDA, Treasury, and HHS. Low-income census tracts with a substantial number or share of residents with low levels of access to retail outlets selling healthy and affordable foods are defined as food deserts. A census tract is a small, relatively permanent subdivision of a county that usually contains between 1,000 and 8,000 people but generally averages around 4,000 people.

Census tracts qualify as food deserts if they meet low-income and low-access thresholds:

***Low-income*:** a poverty rate of 20 percent or greater, or a median family income at or below 80 percent of the statewide or metropolitan area median family income;

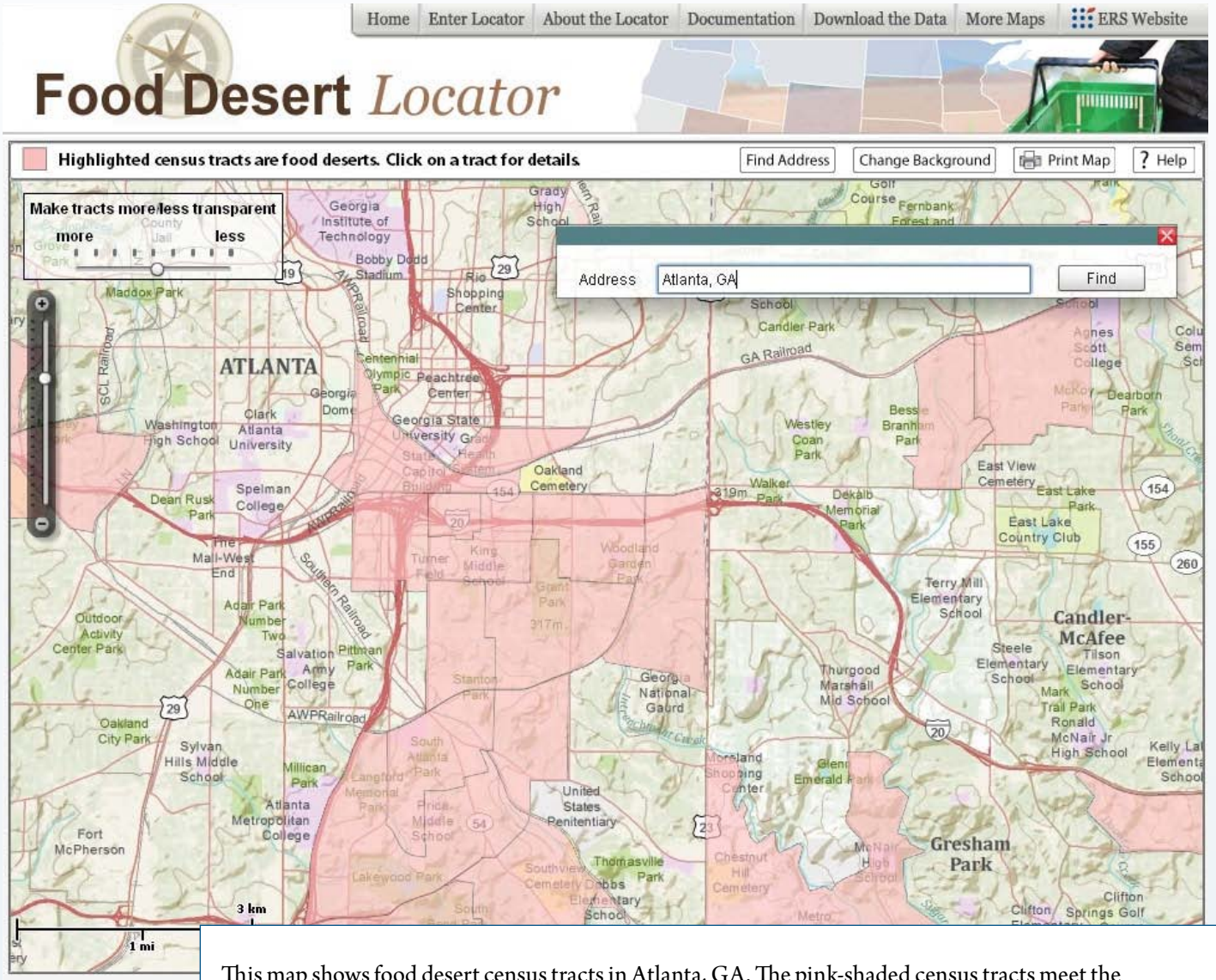
Low-access: at least 500 persons and/or at least 33 percent of the population lives more than 1 mile from a supermarket or large grocery store (10 miles, in the case of rural census tracts).

Data on population and income come from the 2000 Census of Population and Housing.

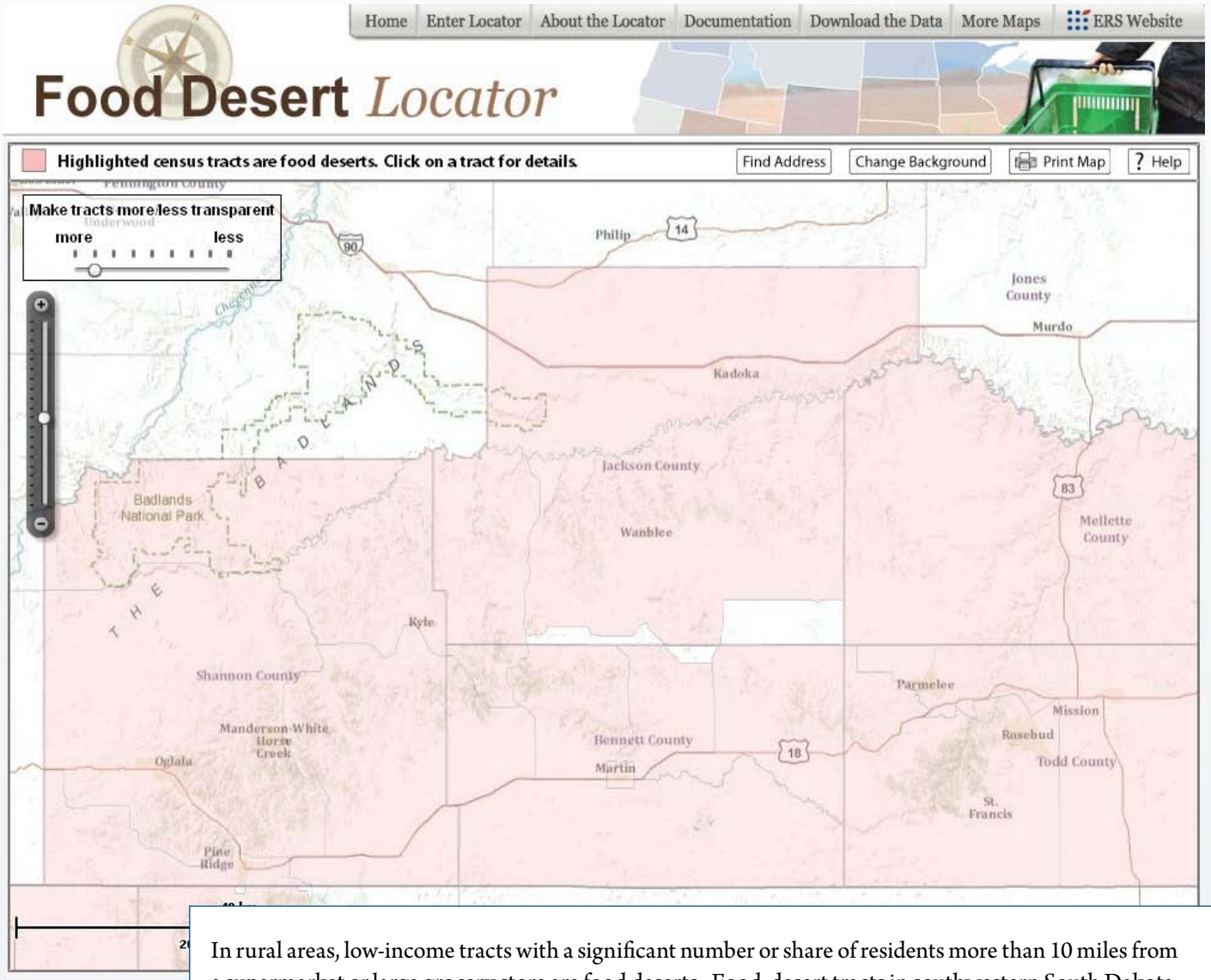
Supermarkets and large grocery stores—defined as foodstores with at least $2 million in annual sales and containing all the major food departments—are used as proxies for sources of healthy and affordable food. A directory of these stores was developed from a 2006 list of stores authorized to accept USDA Supplemental Nutrition Assistance Program (SNAP) benefits, augmented by 2006 data from Trade Dimensions TDLinx (a Nielsen company), a proprietary source of individual supermarket store listings. According to these definitions and data sources, an estimated 13.5 million people in the United States have low access to a supermarket or large grocery store, with 82 percent living in urban areas.

What Can Users Do With the Food Desert Locator?

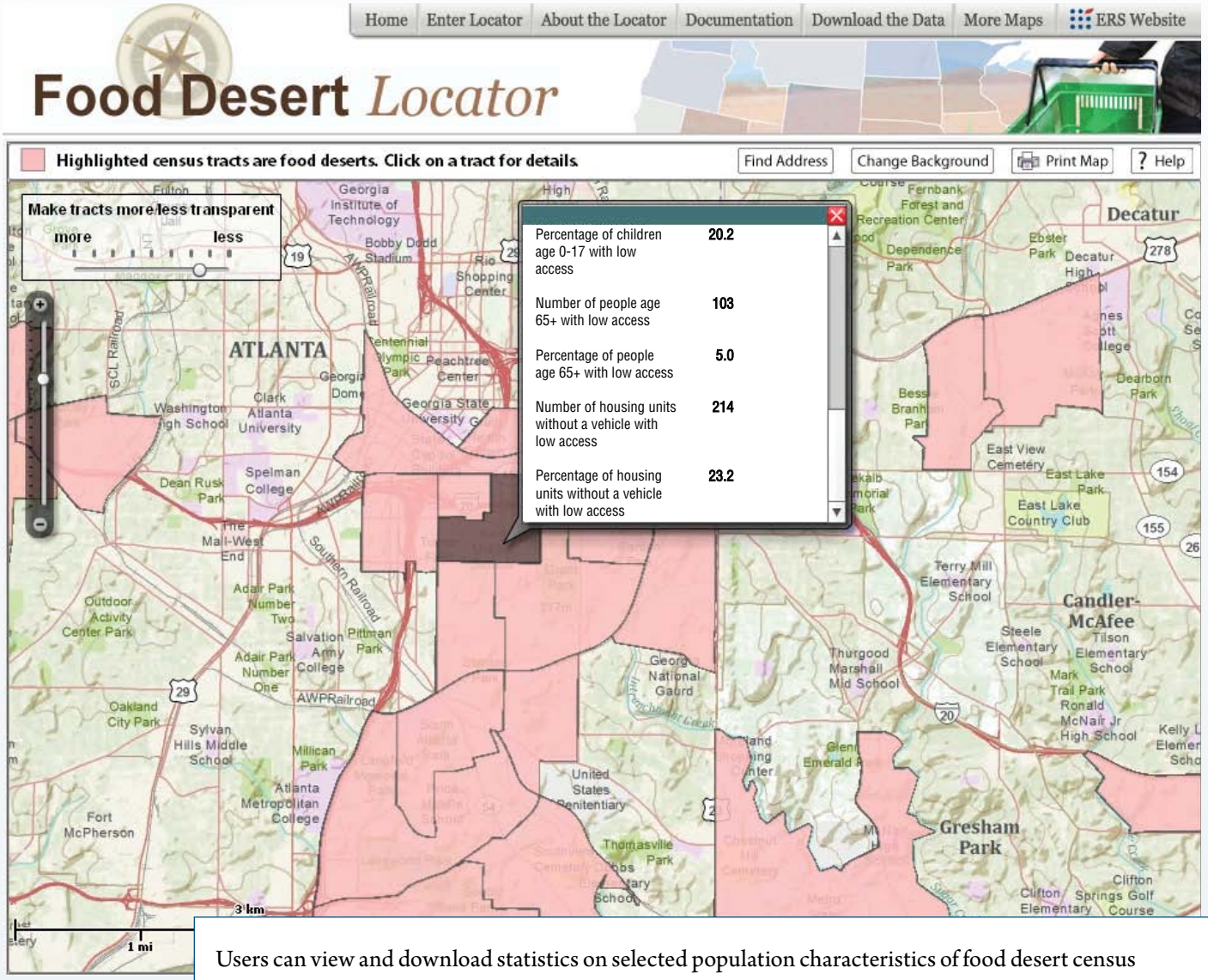
By typing the city, town, or address of interest into the *Find Address* button, the Food Desert Locator can be used to create maps showing food-desert census tracts for specific communities. The following maps provide examples.



This map shows food desert census tracts in Atlanta, GA. The pink-shaded census tracts meet the definition of food deserts–low-income sections of Atlanta where a substantial number or share of residents live more than 1 mile from a supermarket or large grocery store. The map shows several food desert tracts south of the downtown area.



In rural areas, low-income tracts with a significant number or share of residents more than 10 miles from a supermarket or large grocery store are food deserts. Food desert tracts in southwestern South Dakota include sections of the Pine Ridge and Rosebud Indian Reservations.



Users can view and download statistics on selected population characteristics of food desert census tracts—such as the number and percentage of children under age 18, seniors age 65 and older, people with low incomes, and housing units without a vehicle—from the Food Desert Locator. For example, looking at the Atlanta map and clicking on one of the food desert tracts indicates that over 200 households, or 23 percent of households in the tract, are over 1 mile from a supermarket and do not own a vehicle.

This article is drawn from . . .

ERS Food Desert Locator, available at: www.ers.usda.gov/data/fooddesert/

Data are current as of October 2011.

Farm, Rural, and Natural Resource Indicators

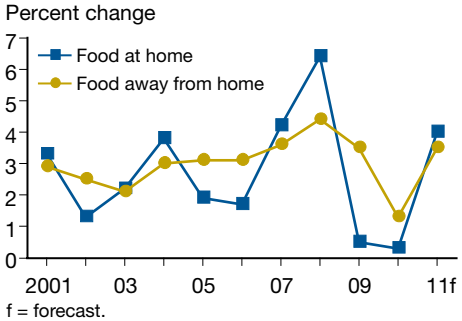
	2007	2008	2009	2010	2011	Annual percent change 2007-08	2008-09	2009-10	2010-11
Cash receipts ($ bil.)	288.5	318.3	283.4	312.3f	340.4f	10.3	-11.0	10.2	18.6
Crops	150.1	176.8	163.7	170.9f	206.5f	17.8	-7.4	4.4	20.8
Livestock	138.5	141.5	119.8	141.5f	163.8f	2.2	-15.3	18.1	15.8
Direct government payments ($ bil.)	11.9	12.2	12.3	12.2f	10.2f	2.5	0.8	-0.8	-16.4
Gross cash income ($ bil.)	318.0	352.0	317.6	345.6f	399.1f	10.7	-9.8	8.8	15.5
Net cash income ($ bil.)	77.7	90.4	69.1	91.3f	114.8f	16.3	-23.6	32.1	25.7
Net value added ($ bil.)	117.2	136.6	112.1	129.0f	157.0f	16.6	-17.9	15.1	21.7
Farm equity ($ bil.)	1,841.2	1,780.6	1,811.8	1,880.8f	2,082.1f	-3.3	1.7	3.8	10.7
Farm debt-asset ratio	10.4	12.0	11.9	11.3f	10.4f	15.4	-0.8	-5.0	-8.0
Farm household income ($/farm household)	88,796	79,796	77,169	83,021f	86,352f	-10.1	-3.3	7.6	4.0
Farm household income relative to average U.S. household income (%)	131.3	116.6	113.5	na	na	na	na	na	na
Nonmetro-metro difference in poverty rate (% points)[1]	3.5	2.2	2.7	na	na	na	na	na	na
Cropland harvested (million acres)	312	316	310	315p	na	1.3	-1.9	1.6	na
USDA conservation program expenditures ($ bil.)[1,2]	4.5	5.2	4.9	5.7	6.2p	15.6	-6.0	16.1	8.7

Food and Fiber Sector Indicators

U.S. gross domestic product ($ bil.)	14,062	14,369	14,119	14,698f	na	2.2	-1.7	4.1	na
Share of agriculture & related industries in GDP (%)[1]	4.6	4.6	4.6	4.6f	na	na	na	na	na
Share of agriculture in GDP (%)[1]	0.8	0.9	0.7	0.9f	na	na	na	na	na
Total agricultural imports ($ bil.)[2]	70.1	79.3	73.4	79.0	94.5f	13.1	-7.4	7.6	19.6
Total agricultural exports ($ bil.)[2]	82.2	114.9	96.3	108.7	137.0f	39.8	-16.2	12.9	26.0
Export share of the volume of U.S. agricultural production (%)[1]	21.8	21.7	19.8f	21.0f	na	na	na	na	na
CPI for food (1982-84=100)	202.9	214.1	218.0	219.7	227.8f	5.5	1.8	0.8	3.7
Share of U.S. disposable income spent on food (%)	9.6	9.5	9.4	na	na	na	na	na	na
Share of total food expenditures for at-home consumption (%)	52.8	53.4	53.5	na	na	na	na	na	na
Farm-to-retail price spread (1982-84=100)	248.1	267.0	269.3	269.3	na	7.6	3.6	-2.6	na
Total USDA food and nutrition assistance spending ($ bil.)[2]	54.3	60.9	79.2	95.4	na	12.2	30.0	20.5	na

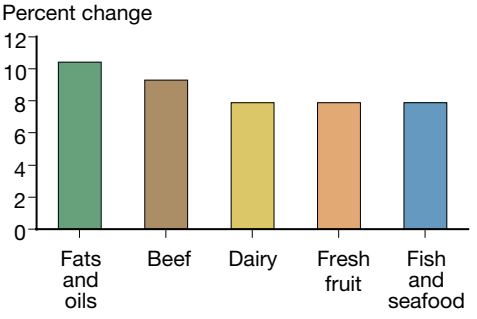
f = Forecast. p = Preliminary. na = Not available. All dollar amounts are in current dollars.
[1]The methodology for computing these measures has changed. These statistics are not comparable to previously published statistics.
[2]Based on October-September fiscal years ending with year indicated.
Sources and computation methodology are available at: www.ers.usda.gov/amberwaves/indicatorsnotes.htm

Food price inflation up in 2011 but not to 2008 levels

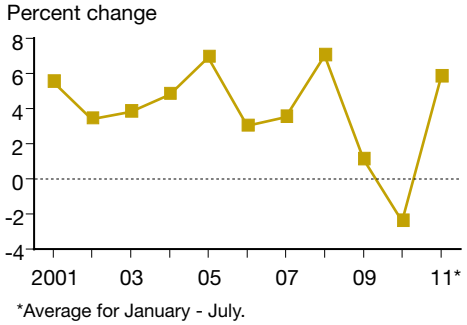


f = forecast.

Fats and oils and beef led food price increases in July 2010-July 2011



Supermarket margins—revenues minus wholesale costs—bounced back in 2011

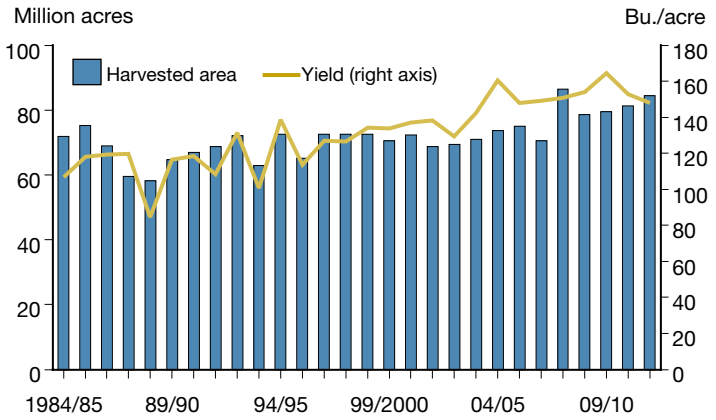


*Average for January - July.

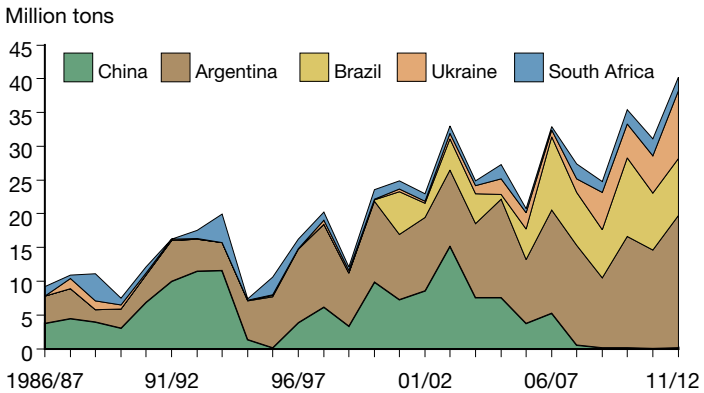
For more information, see www.ers.usda.gov/amberwaves/

Markets and Trade

U.S. corn yield dips in 2011/12…



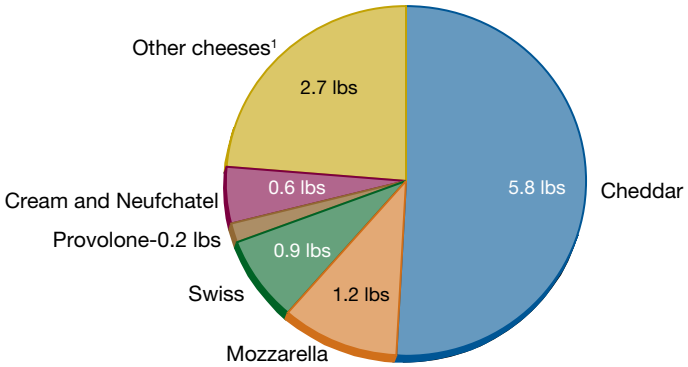
…while U.S. competitors increase their share of world corn exports



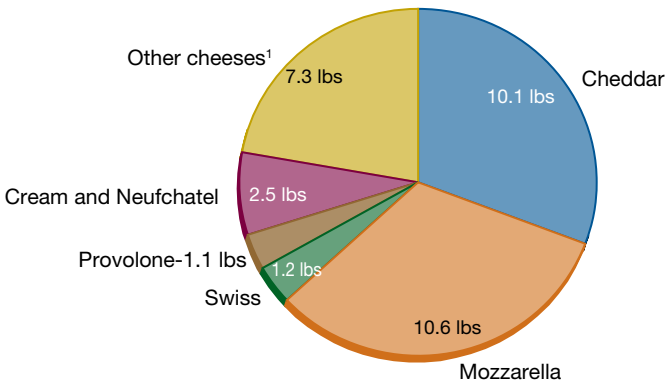
Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, *Grain: World Markets and Trade (Grain Circular)*.

Diet and Health

In 1970, cheddar accounted for half of the 11.4 pounds of cheese per person consumed by Americans



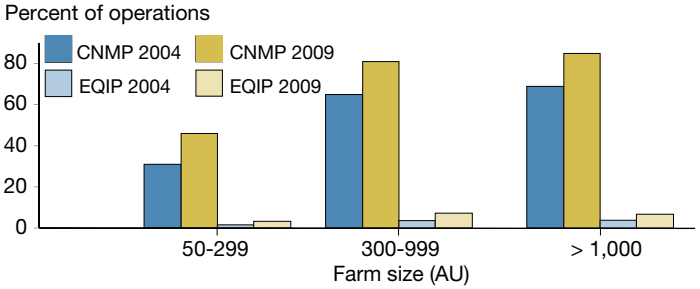
In 2009, mozzarella ranked first, with a 32-percent share of the 32.8 pounds of cheese consumed per person



[1]Other cheeses include Colby, Monterey Jack, Romano, Parmesan, blue, Gruyere, Emmenthaler, Gorgonzola, and miscellaneous cheeses.
Source: USDA, Economic Research Service, Food Availability data.

Resources and Environment

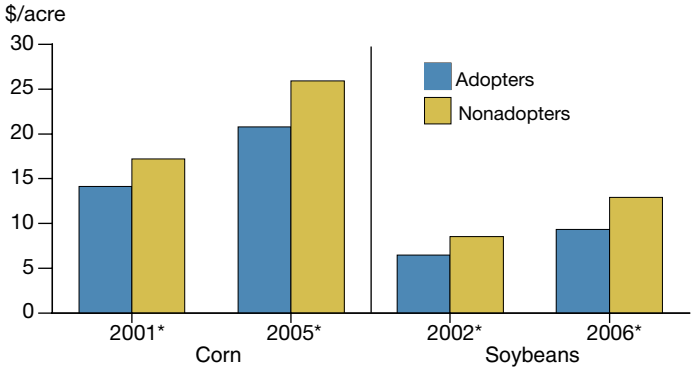
More hog operations adopted nutrient management plans and received EQIP payments in 2009



CNMP = Comprehensive Nutrient Management Plan; EQIP = Environmental Quality Incentives Program. Note: Animal units (AU) are defined as 1,000 pounds of live animal weight, and the inventory of AUs is based on an estimate of the average number of hogs and pigs on the operation in each year.
Source: USDA, Economic Research Service using USDA's 2004 and 2009 Agricultural Resource Management Surveys.

Farms, Firms, and Households

Fuel expenses were lower for yield monitor adopters than for nonadopters



*= statistically significant difference of means at 10-percent level.
Source: USDA, Economic Research Service using USDA's Agricultural Resource Management Survey.

On the Map

Demand for U.S. Edible Pork Byproduct Exports Is High

U.S. pork byproduct exports totaled $700 million in 2010, almost 15 percent of the total value of U.S. pork exports. Fresh or chilled offal is the leading edible byproduct export (13 percent). Other exports include hog feet (11 percent), rinds (8 percent), guts, bladders, and stomachs (8 percent), frozen intestines (7 percent) and all other frozen pork offal (45 percent). China and Mexico accounted for 68 percent of U.S. edible pork byproduct exports in 2010. In foreign markets, demand for U.S. edible offal is high because of its superior quality and low prices relative to domestic products.

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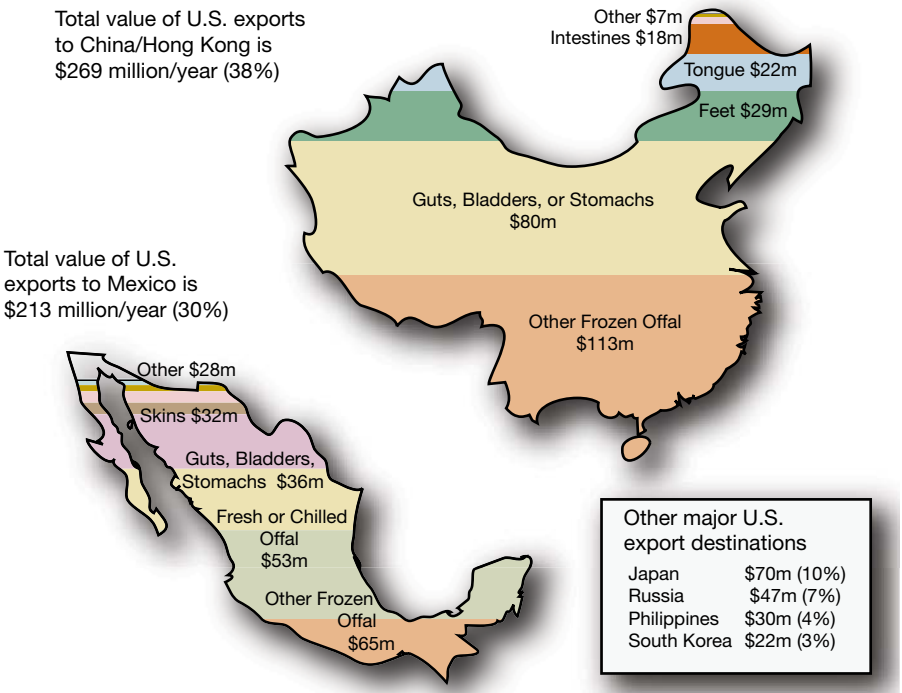
U.S. edible pork byproduct export markets, 2010



Source: USDA, Economic Research Service using USDA Foreign Agricultural Service, Global Agricultural Trade System.

In the Long Run

Prevalence of Food Insecurity Remained Essentially Unchanged in U.S. Households

After a sharp increase from 2007 to 2008, the prevalence of food insecurity remained essentially unchanged in 2009 and 2010 at 14.5 percent. Food-insecure households had difficulty at times during the year providing enough food for all their members due to a lack of resources. The prevalence of very low food security, the more severe range of food insecurity characterized by reduced food intake and disrupted eating patterns, declined from 5.7 percent in 2009 to 5.4 percent in 2010. In the 2001 recession, food insecurity rose and continued to increase through 2004, even though economic growth resumed in 2002.

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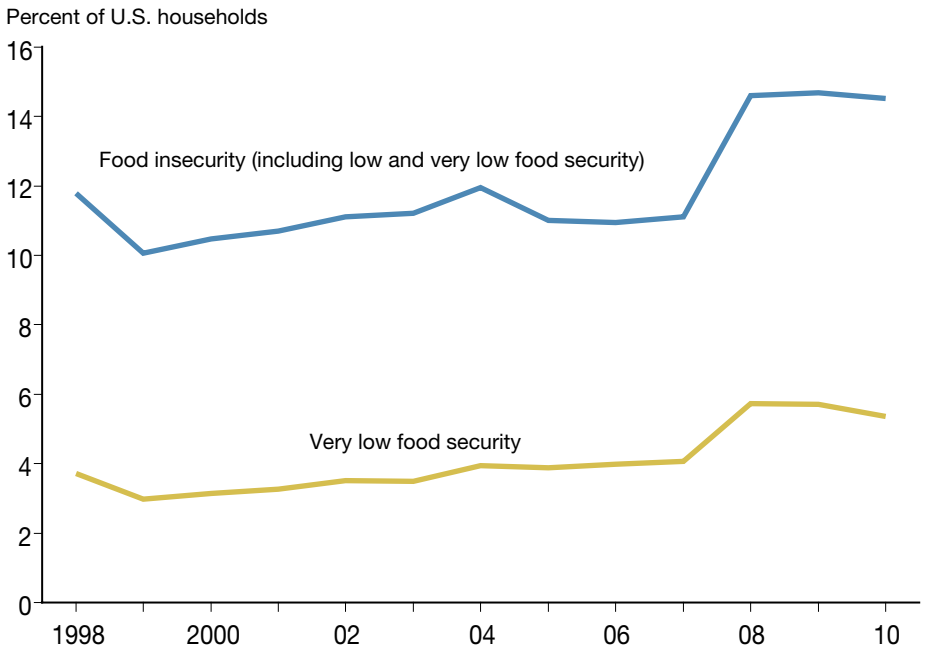
Prevalence rates of food insecurity and very low food security



Source: USDA, Economic Research Service using Current Population Survey Food Security Supplement data.